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THE LIMESTONE INDUSTRY IN NEW BRUNSWICK

VOLUME I - REPORT

by

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IN NEW BRUNSWICK

VOLUME I - REPORT

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TABLE OF CONTENTS

		Page
LIST OF TABLES		II
LIST OF FIGURES		IV
LIST OF APPENDICES		V
1.	INTRODUCTION AND TERMS OF REFERENCE	1
2.	OBJECT OF REPORT	3
3.	PRESENT AND FUTURE SUPPLY/DEMAND SITUATION	4
	Overview	4
	Production and Shipments	4
	Capacity	11
	Demand	11
	Value of Production	15
	Producers and Supply	15
	Reserves	20
	Chemical Process Stone	21
	Markets	21
	Specifications	25
	Prices	29
	Pulverized Stone	30
	Agricultural Limestone and Fertilizer Filler	34
	Fish Farming and Sports Fishery	57
	Animal Feed Supplement	60
	Peat and Peat-Soil Mixes	62
	Fillers, Extenders, Coatings and Whiting Substitute	66
	Carpet Backing	66
	Rubber	67
	Paper	67
	Paint	73
	Plastics and fiberglass	75
	Asphalt filler	75
	Suppliers	75
	Crushed and Building Stone	80
	Production Statistics	81
	Products, Specifications and Prices	84
	Lime	88
	History	89
	Specifications	97
	Prices	101
	Transportation and Handling	104
	Markets	106
	Cement	113
4.	CONCLUSIONS AND RECOMMENDATIONS	114

LIST OF TABLES

		Page
Table I:	Historical Summary of New Brunswick Limestone Production, Based on Annual Shipments or Sales of Products	6
Table II:	Atlantic Provinces Production (Sales) of Chemical Process and Pulverized Limestone Products	12
Table III:	Value of Limestone Production (Shipments) in New Brunswick - Excluding Stone for Production of Cement and Lime, but Including Marl, Dolomite and Marble	17
Table IV:	Identified Chemical Process Stone Markets and Prospective Markets	22
Table V:	History of Chemical Process Stone Shipments from New Brunswick Producers	26
Table VI:	Sales of New Brunswick Pulverized Stone Production, by Market	31
Table VII:	Identified Fertilizer Filler Markets Accessible or Potentially Accessible by New Brunswick Limestone Producers	47
Table VIII:	Limestone Consumption and Specifications for Peat-Soil Mixes	63
Table IX:	Paper Production Capacity in Maine	70
Table X:	"Albafil" Slurry Specifications - Pfizer	76
Table XI:	Canadian Production (Sales) of Whiting (Substitute) Manufactured by Pulverizing Limestone or Marble	78
Table X:	New Brunswick Crushed Stone Categories in 1972 and 1973	81
Table XIII:	Crushed Stone Production (Sales) in New Brunswick, 1946-1983	82
Table XIV:	Crushed Stone Products of Higher Unit Value, 1955-1961	83
Table XV:	Definitions and Specifications of Selected Crushed Stone Construction Uses	84

Table	XVI:	Crushed Limestone Products, Uses and F.O.B. Prices, 1985-1986	85
Table	XVII:	Market Distribution of Brookville Crushed Stone Products	86
Table	XVIII:	Havelock Sales of Lime, 1984-1985	89
Table	XIX:	Production of Lime in New Brunswick and Nova Scotia Showing Purposes for Which Used or Sold	91
Table	XX:	Production of Lime Sold or Used - New Brunswick and Nova Scotia, 1923-1936	93
Table	XXI:	Operators in the New Brunswick and Nova Scotia Lime Industry	94
Table	XXII:	Number of Lime (Quick or Hydrated) Producing Firms, Employees, Salaries and Production - New Brunswick and Nova Scotia	96
Table	XXIII:	Typical Specifications of Some High Calcium Quicklime of Various Producers	100
Table	XXIV:	Lime Prices from Price Lists of Various Producers, 1985-1986	101
Table	XXV:	Lime Exports from New Brunswick, 1974-1985 (Quick and Hydrated)	103
Table	XXVI:	Transportation Cost from Competing Lime Production Areas to Selected Market Areas	104
Table	XXVII:	Principal Specific Quicklime Markets which are Served or Possibly Could be Served from New Brunswick	107
Table	XXVIII:	Specific Developing or Prospective Markets in the Atlantic Region for Quick and Hydrated Lime	110
Table	XXIX:	Specific Bulk Hydrated Lime Markets	111
Table	XXX:	Specific Bagged Hydrated Lime Markets	112

LIST OF FIGURES

		Page
Figure 1:	Limestone Production in New Brunswick	9
Figure 2:	Relationship Between Limestone Production and Construction Activity in New Brunswick	10
Figure 3:	Quantity of Pulverized Stone Production in New Brunswick Compared with Total Limestone Production	16
Figure 4:	Outline Map, Location of Major Limestone Occurrence, Quarries and Plants in New Brunswick	18
Figure 5:	Pulverized Stone Production in New Brunswick	33
Figure 6:	Subsidized Aglime Production in New Brunswick	37
	Subsidized Aglime Compared with Total Aglime and Fertilizer Filler Production in New Brunswick	
Figure 7:	Aglime and Fertilizer Filler Production in New Brunswick	40
Figure 8:	Value of Aglime and Fertilizer Filler Production in New Brunswick	41
Figure 9:	Soil Analysis Report	43
Figure 10:	Land Under Crops and Pasture in New Brunswick and Prince Edward Island	51
	Percentage of Total Land Area in Farms	
Figure 11:	Comparison of New Brunswick and Canadian Aglime and Fertilizer Filler Production at 5-year Intervals	52
Figure 12:	Fertilizer Sales in New Brunswick and the Atlantic Provinces	53
	Plant Food Units per Tonne of Fertilizer Sold in the Atlantic Provinces	
Figure 13:	Average Food Units per Tonne of Fertilizer in 1985	54
Figure 14:	Agricultural Limestone Sales in the Atlantic Provinces	55
Figure 15:	"Merrithew: Forests in Danger"	59

LIST OF APPENDICES

Appendix I: 1. New Brunswick and Nova Scotia Agricultural Limestone Assistance Programs

2. "Atlantic Soils Need Lime" prepared by the Advisory Committee on Soil Fertility and Published by Authority of the Atlantic Provinces Agricultural Services Coordination Committee

3. Statistics on New Brunswick Agricultural Limestone Assistance Program

Appendix II: 1985 Price Lists for Havelock and Brookville Agricultural Limestone Products as Well as Typical Chemical and Physical Properties

Appendix III: Statistics on Agricultural Limestone and Fertilizer Consumption in the Atlantic Provinces - Compiled by the Atlantic Fertilizer Institute

Appendix IV: Natural Lakes in New Brunswick which have had Water Quality Chemically Altered by Addition of Lime

Appendix V: Information Provided by the Atlantic Provinces Transportation Commission on Limestone, Lime, Cement and Aggregate Transportation Rates

Appendix VI: Lime Statistics on Areas of the Eastern United States Which Could be Prospective Markets for an East Coast Producer

Appendix VII: Subsidized Agricultural Limestone Consumption by County - Historical and Present

Appendix VIII: Estimated New Brunswick Limestone and Lime Consumption for 1985, by County

Appendix IX: Flow Sheets of New Brunswick Limestone Producers

Appendix X: Operating Costs for Limestone Quarrying and Processing

Appendix XI: Employment

Appendix XII: Historical Information from Department of Agriculture Annual Reports on New Brunswick Agricultural Limestone Assistance Policy

1. INTRODUCTION AND TERMS OF REFERENCE

This study on the state of the limestone industry in New Brunswick was awarded to the writer by letter dated April 9, 1985 from the Honourable Malcolm N. MacLeod, Minister of Natural Resources. In response to an invitation, the writer had submitted a proposal on Febr ary 14, 1985 to undertake the study at a cost of $19,999.00.

The term "limestone" for purposes of this report includes dolomite, dolomitic limestone and marl. Values are expressed as Canadian dollars, United States dollars, short tons (tons) or metric tons (tonnes) as indicated in the text, tables and figures.

Terms of reference as provided in the information document supplied to bidders include "without limiting the scope of work, . . . the following elements as minimum requirements":

1. Review and summarize the present and future supply/demand situation for limestone products in the Maritimes, and immediately adjacent areas of Canada and the United States. To be more specific, the survey should be directed to market areas which would be accessible to New Brunswick producers (i.e., New Brunswick, Nova Scotia, P.E.I., Maine and possibly parts of eastern Quebec) and should include lists of producers and consumers throughout the study area.

2. Undertake a detailed analysis of the current limestone industry in New Brunswick involving the following:

   a) A historical account of limestone production in the province: annual tonnage figures/value in $ per year/current limestone production by use.

   b) Liaise with companies presently involved in limestone development or exploration in the province concerning: the history of the operation/the chemical and physical specifications of the stone required for the processing of various products/quantities of various products produced as a percentage of total

production/plant capacity/quarry methods employed/ current processing technology employed in manufacturing processes (i.e. schematic flow sheet of operation and equipment in use).

c) Liaise with various consumers of New Brunswick limestone products: required chemical and physical specifications and approximate tonnages required.

d) Prices and costs of various New Brunswick limestone products (bulk and bagged) F.O.B. plant (i.e. ag lime, aggregate, quick-lime, cement, etc.).

e) Use distribution and total limestone consumption by county: tonnes and percent of total.

f) Transportation and handling costs: truck vs rail vs water/report on Lime Transportation Policy Subsidy provided by the New Brunswick Department of Agriculture, etc.

g) Employment generated by the industry.

h) Identify special problems that affect the producer and consumer.

3. Review and list traditional uses for limestone in general and identify new and emerging applications as well. Details of the physical or chemical specifications for all uses should be included.

4. Review possible substitutes for limestone in its various industrial uses, including a definition of the role it plays in the process.

5. Recommend areas where additional research may benefit the future development of the limestone industry in New Brunswick.

Limestone, even when considering only the industry centered in New Brunswick, has so many applications and product variations that it has been necessary to be somewhat arbitrary in deciding what degree of comprehensiveness would address the objective as intended by the call for bids. Certain limestone-based industries, such as the cement and lime industries, could be the subject of significant studies in themselves.

2. OBJECT OF REPORT

The objective of this report cited in the information supplied to bidders is

> "To provide detailed, contemporary information concerning the state of the limestone industry in New Brunswick, including an assessment of the current supply/demand situation in the Province and adjacent areas along with future development opportunities."

3. PRESENT AND FUTURE SUPPLY/DEMAND SITUATION

OVERVIEW

Production and Shipments

Production of limestone in New Brunswick for purposes other than cement and lime manufacture has been on a declining trend since 1975 and, if cement and lime are included, since 1977. The estimated total limestone production in 1977 was 1,293,000 tonnes, and in 1985 was 623,000 tonnes (Table I). If cement and lime manufacture are excluded, the total declined from 880,000 tonnes in 1975 to 457,000 tonnes in 1985 (Figure 1 and 2).

Chemical process stone (for pulp mills, glass plants, smelter flux) after experiencing very dramatic growth of shipments from less than 5,000 tonnes in 1967 to 120,000 tonnes in 1977, declined to 88,000 tonnes in 1982. Shipments have recovered to an estimated 94,000 tonnes in 1985.

Pulverized stone shipments (agricultural, asphalt filler, dusting coal mines) displayed an increasing trend from 96,000 tonnes in 1977 to 164,000 tonnes in 1981. Subsequently, shipments have remained quite steady and were an estimated 161,000 tonnes in 1985. The 1977-81 growth period was preceded by an abrupt decline from 198,000 tonnes in 1976 after uninterrupted growth from 85,000 tonnes in 1971.

Limestone consumption for the manufacture of lime has grown from nothing in 1970 to an estimated 107,000 tonnes in 1985.[1] The lack of production in 1969 and 1970 was the result of a fire which had destroyed the Snowflake Lime calcining facility at Saint John late in 1968. How-

1. Since 1971, Statistics Canada has published only value of lime production (shipments) in order to protect the single producer. In January 1984 a public company, Dickenson Mines Ltd., acquired the producer and publishes quantity of lime sold in its annual report.

ever, there was a market for lime during this period because "according to railway freight traffic data, over 23,000 tons of lime was off loaded in the Maritime Provinces during 1968, exclusive of any volume . . . moved by truck."[2]

Limestone production (shipments) for manufacture of cement is not published by Statistics Canada in order to protect the single producer. Nevertheless, as in the case of lime, a reasonable approximation of quantity can be derived using cement selling price index and projecting from the mid-1960's when both selling price and quantity were published. Using this approach, it is readily apparent that limestone quarried for cement production peaked at more than 500,000 tonnes in 1977 and declined to slightly more than 200,000 tonnes by 1982 before the Havelock plant of Canada Cement Lafarge began to serve as a producer of specialty cement, particularly for offshore petroleum drilling, and as a clinker grinding and distribution facility. Average annual limestone production for cement manufacture is now 50-70,000 tonnes, or less.

Crushed limestone (aggregate for concrete and asphalt, rubble, rip-rap, road metal, poultry grit) production has reflected construction activity, most specifically major projects located in areas of limestone quarries. (Figure 2). Construction of the Coleson Cove electricity generating station and the Point Lepreau nuclear plant coincide with 1975 and 1980 production (shipments) peaks of 658,000 and 688,000 tonnes, respectively. This compares with annual production in the past four years in the 200-300,000 tonne range.

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2. Canadian Minerals Yearbook

TABLE I

Historical Summary of New Brunswick Limestone Production, Based on Annual Shipments or Sales of Products

Year	Chemical Process Stone	Pulverized Stone	Crushed & Building Stone	Quick & Hydrated Lime Manufacture[1]	Cement[2] Manufacture	Limestone Total
				(short tons)		
1886	n/a	n/a	n/a	16,610	0	16,610
1887	n/a	n/a	n/a	25,116	0	25,116
1888	n/a	n/a	n/a	23,112	0	23,112
1889	n/a	n/a	n/a	52,799	0	52,799
1890	n/a	n/a	n/a	42,770	0	42,770
1891	n/a	n/a	n/a	3,540	0	3,540
1906	n/a	n/a	n/a	21,287	0	21,287
1907	n/a	n/a	n/a	29,104	0	29.104
1908	n/a	n/a	n/a	8,177	0	8,177
1909	n/a	n/a	n/a	36,617	0	36,617
1910	n/a	n/a	n/a	24,678	0	24,678
1911	n/a	n/a	n/a	32,220	0	32,220
1912	n/a	n/a	n/a	32,384	0	32,384
1913	n/a	n/a	n/a	20,631	0	20,631
1914	n/a	n/a	n/a	20,567	0	20,567
1915	n/a	n/a	n/a	19,379	0	19,379
1916	2,500	n/a	n/a	22,266	0	24,766
1917	8,500	n/a	n/a	27,944	0	36,444
1918	n/a	n/a	n/a	25,334	0	25,334
1919	3,461	n/a	n/a	24,599	0	28,240
1920	6,081	589	n/a	36,848	0	43,518
1921	n/a	6,666	n/a	29,529	0	36,195
1922	n/a	5,710	n/a	29,444	0	35,154
1923	10,689	3,196	n/a	17,301	0	31,186
1924	11,732	4,331	n/a	10,929	0	26,992
1925	14,000	8,679	n/a	10,611	0	33,290
1926	13,800	8,646	2	25,055	0	47,503
1927	14,100	10,029	23	18,014	0	42,166
1928	15,017	9,415	6,340	16,892	0	47,664
1929	17,580	2,130	1,000	23,277	0	43,987
1930	21,769	18,493	0	18,782	0	59,044
1931	19,880	15,498	0	16,862	0	52,240
1932	0	9,864	843	17,358	0	28,065
1933	3,892	10,350	20	25,274	0	39,536
1934	3,855	19,666	6,835	23,628	0	53,984
1935	4,558	14,500	34,155	24,558	0	77,771
1936	4,720	5,300	43,761	26,763	0	80,544
1937	6,592	4,368	40,969	29,849	0	81,778

Year	Chemical Process Stone	Pulverized Stone	Crushed & Building Stone	Quick & Hydrated Lime Manufacture[1]	Cement Manufacture[2]	Limestone Total
1938	2,030	5,955	0	22,870	0	30,856
1939	2,340	48,453	1,712	28,013	0	80,518
1940	5,520	48,362	105,930	31,854	0	191,666
1941	5,700	60,545	65,696	32,628	0	164,569
1942	6,373	71,025	5,225	33,641	0	116,264
1943	4,276	46,678	452	26,073	0	77,479
1944	4,245	62,467	19	29,697	0	96,428
1945	3,088	81,319	232	29,912	0	114,551
1946	4,847	107,135	3,583	32,873	0	148,438
1947	5,320	100,363	6,522	31,407	0	143,612
1948	6,500	106,683	18,937	34,326	0	166,446
1949	4,032	94,748	26,184	34,623	0	159,587
1950	12,493	70,399	21,834	35,541	0	140,267
1951	7,624	95,364	39,960	31,431	0	174,379
1952	6,588	54,737	52,255	29,756	140,610	283,946
1953	7,939	54,401	67,163	31,776	191,763	353,042
1954	7,933	52,566	55,633	33,800	198,957	348,889
1955	7,273	52,391	364,026	28,292	203,111	655,093
1956	377	48,116	455,239	27,470	220,091	751,293
1957	766	53,893	443,242	27,648	217,641	743,200
1958	682	65,981	132,848	22,343	239,621	461,475
1959	598	72,761	65,821	27,347	227,155	393,682
1960	2,671	68,458	227,917	25,091	217,116	541,253
1961	7,957	83,538	255,279	20,730	227,368	594,872
1962	7,948	82,858	776,275	26,012	225,865	1,118,958
1963	5,268	110,567	639,009	25,379	215,238	995,461
1964	0	102,417	690,500	7,460	231,737	1,032,114
1965	5,848	110,042	250,500	5,331	235,748	607,469
1966	212,551(?)	135,517	(34,068)?	5,601	331,213	650,814
1967	5,260	103,815	242,925	4,323	305,993	662,316
1968	11,502	146,127	335,371	3,911	194,000[5]	691,004[4]
1969	30,275	139,190	131,535	0	245,000	546,000
1970	32,160	148,697	104,143	0	220,000	505,000
1971	73,038[3]	93,309	259,653	46,000[4]	183,000	655,000
1972	45,857	123,684	240,459	48,000	262,000	720,000
1973	57,304	150,397	367,299	60,000	312,000	947,000
1974	68,989	120,285	598,000[4]	70,000	242,000	1,099,000
1975	129,914	190,621	658,000	78,000	258,000	1,314,000
1976	79,356	218,639	498,000	87,000	382,000	1,265,000
1977	132,214	105,798	591,000	87,000	509,000	1,425,000
1978	121,000[4]	147,000[4]	481,000	100,000	393,000	1,242,000
1979	125,000	157,000	335,000	105,000	373,000	1,095,000
1980	99,000	157,000	688,000	90,000	286,000	1,320,000
1981	97,000	181,000	277,000	104,000	321,000	980,000
1982	98,000	176,000	257,000	100,000	234,000	865,000
1983	104,000	176,000	209,000	n/a	n/a	610,000
1984	n/a	182,000	n/a	120,000	n/a	610,000
1985	104,000	177,000	223,000	118,000	65,000	687,000
					TOTAL	29,950,000 (short tons)

1. Estimated by multiplying reported lime production by 1.5. A portion of reported lime is hydrated, thus this factor is used rather than the 1.78 theoretical factor for determining the amount of $CaCO_3$ required to yield 1 unit weight of CaO.

2. Estimated by multiplying reported cement production by 1.33, which is the approximate ratio of limestone used by Canadian cement plants to Canadian cement output.

3. Of which 39,127 short tons were shipped to foreign lime kilns.

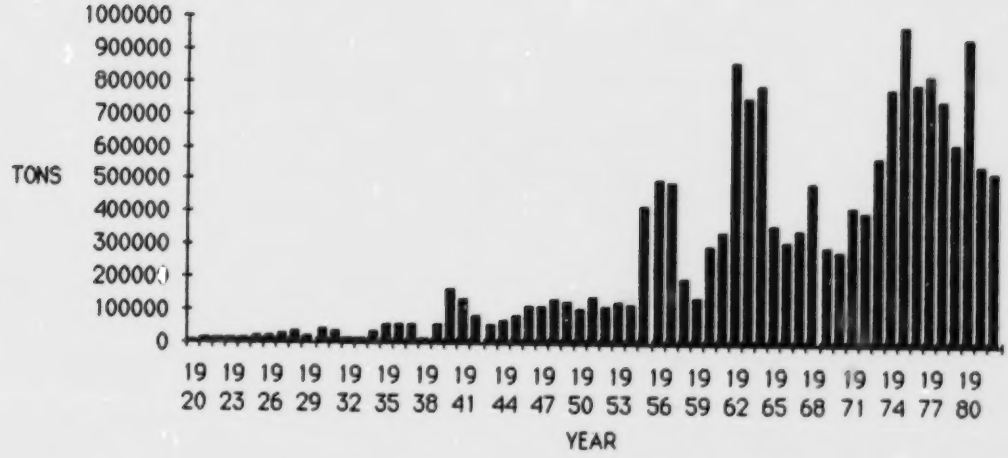
4. Estimated to within 20% of actual and rounded to nearest 1000 for this and subsequent years.

5. Calculated for 1968-1982, using Statistics Canada value of cement production and cement selling price index. Calculated limestone quantity rounded to nearest 1000.

SOURCES: Statistics Canada Catalogue 26-225, 44-001, 44-204, 44-209 and predecessor or successor numbers; Hamilton (1965); N. B. Department of Agriculture Annual Reports; Canadian Minerals Yearbooks; and industry sources for recent years, including annual reports for Dickenson Mines Limited.

Figure 1

LIMESTONE PRODUCTION IN NEW BRUNSWICK



LIMESTONE PRODUCTION IN NEW BRUNSWICK WITH TREND LINE SUPERIMPOSED (Statistics Canada Catalogue 26-225 & predecessors; 1921-2 estimated; excluding stone for production of cement and lime, but including marl, dolomite and marble)

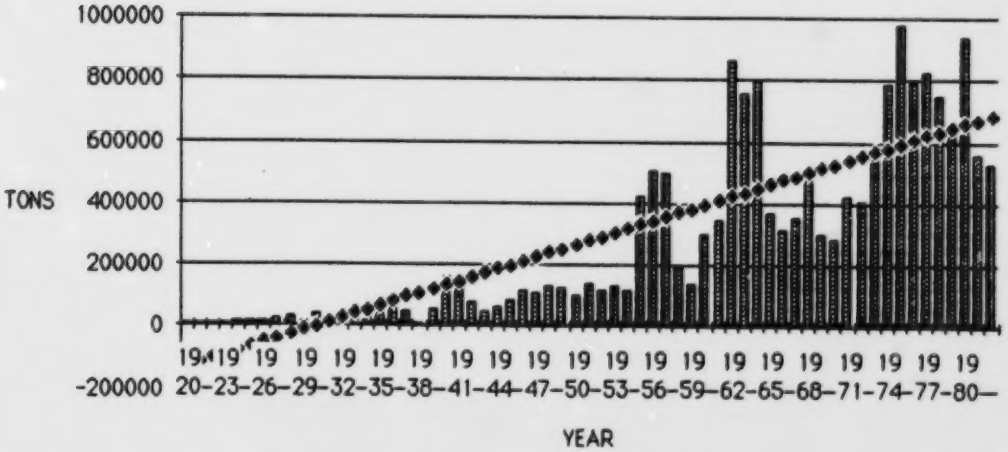
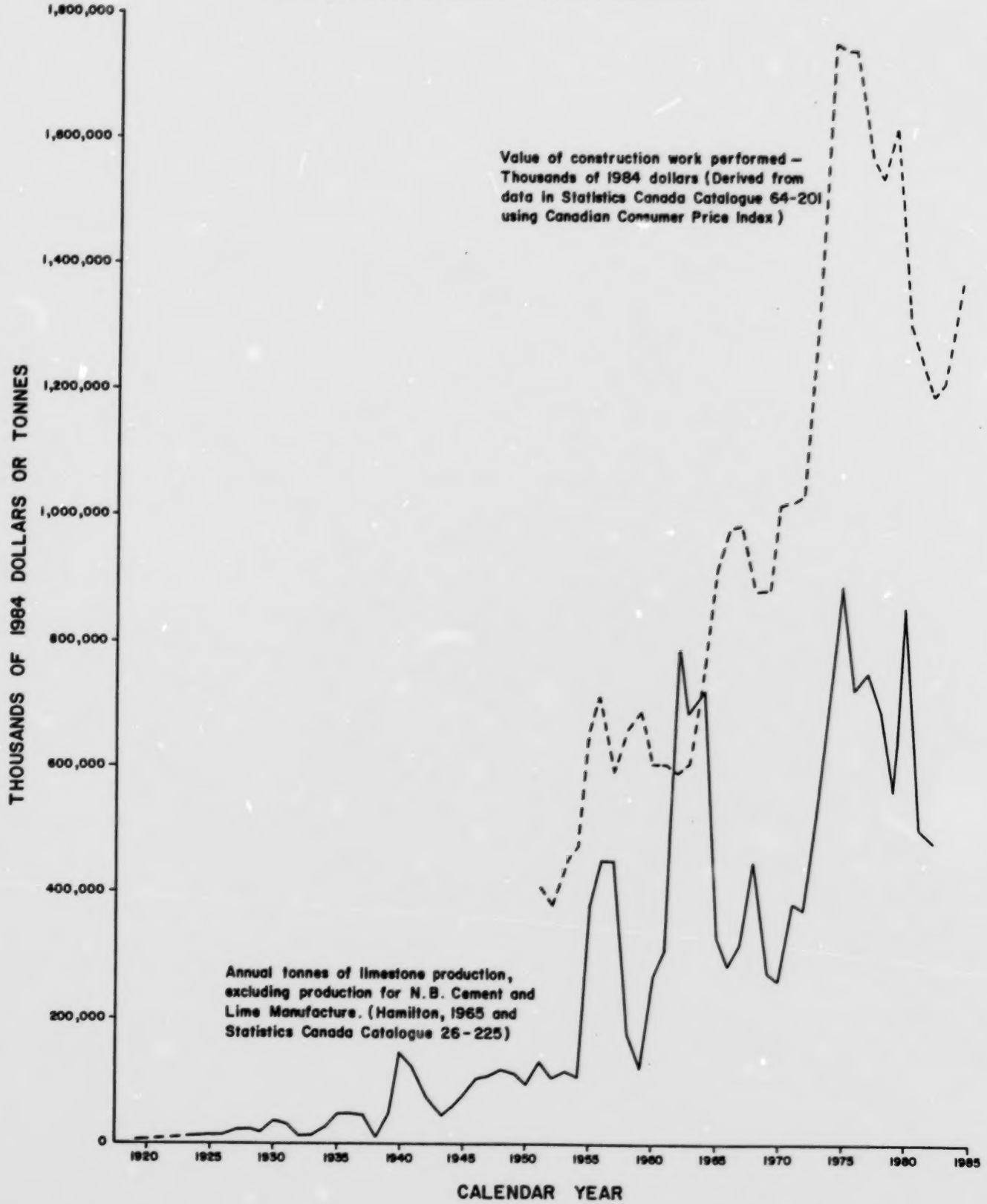


Figure 2

RELATIONSHIP BETWEEN LIMESTONE PRODUCTION AND CONSTRUCTION ACTIVITY IN NEW BRUNSWICK



Capacity

Current annual capacity for crushing limestone at existing plants exceeds 3,000,000 tonnes, including Canada Cement Lafarge and assuming 350 8-hour operating days per year. On the same basis, but excluding Canada Cement, pulverizing capacity exceeds 500,000 tonnes per annum. It is readily apparent that New Brunswick limestone producers have the capacity to supply more than four times the existing market demand. There is no evidence that this capability is limited by reserves or the probability of not being able to quantify the required reserves.

Demand

Over 90 percent of total demand for limestone products in the Atlantic Provinces is supplied by local producers. All lime produced in the region and some 65 percent of the chemical process stone are being supplied from New Brunswick. Table II presents the historical production (shipments) of chemical process stone and pulverized stone for the Atlantic Provinces. New Brunswick has not only gained relative to the other provinces, but also has a much more even record of production.

Historic market demand for all products experienced relatively abrupt increases and declines as industries opened, closed and changed technology. This effect, and especially the effect of major construction projects, suggests that it is virtually impossible to base any intermediate term forecast of demand on general economic growth predictions for the Atlantic Region. The relatively small size of the market and number of major buyers are principal factors in limiting the usefulness of a link between forecast general economic growth and limestone production. The likelihood of enforcement of more stringent sulphur dioxide emission standards will result in the only predictable significant growth component of limestone markets.

TABLE II

ATLANTIC PROVINCES PRODUCTION (SALES) OF CHEMICAL PROCESS AND PULVERIZED LIMESTONE PRODUCTS

(SOURCE: STATISTICS CANADA CATALOGUE 26-225 AND PREDECESSOR CATALOGUES)

Year	NEW BRUNSWICK									NOVA SCOTIA									NEWFOUNDLAND									ATLANTIC PROVINCES								
	Chemical Process Stone			Pulverized Stone			Total			Chemical Process Stone			Pulverized Stone			Total			Chemical Process Stone			Pulverized Stone			Total			Chemical Process Stone			Pulverized Stone			Total		
	Tons x1000	$ x1000	$/T	Tons x1000	$ x1000	$/T	Tons x1000	$ x1000	$/T	Tons x1000	$ x1000	$/T	Tons x1000	$ x1000	$/T	Tons x1000	$ x1000	$/T	Tons x1000	$ x1000	$/T	Tons x1000	$ x1000	$/T	Tons x1000	$ x1000	$/T	Tons x1000	$ x1000	$/T	Tons x1000	$ x1000	$/T	Tons x1000	$ x1000	$/T
1925	14	26	1.86	9	26	2.89	23	52	2.26	84	71	.85	ø	ø	ø	84	71	.85	n/a	n/a		n/a	n/a												
1930	22	42	1.91	18	55	3.06	40	98	2.45	79	82	1.04	1.4	6.5	4.64	80.4	88.5	1.10	n/a	n/a														
1935	5	7	1.40	15	45	3.00	19	52	2.74	5.0	8.4	1.69	3.4	9.7	2.85	8.4	18.1	2.15	n/a	n/a		n/a	n/a												
1940	6	10	1.67	48	111	2.31	54	122	2.26	3.8	11.7	3.08	19.6	34.3	1.75	23.4	46.0	1.97	n/a	n/a		n/a	n/a												
1945	3	6	2.00	81	192	2.37	84	198	2.36	18.4	47	2.55	42	111	2.64	60.4	158	2.62	n/a	n/a		n/a	n/a												
1950	13	34	2.62	70	215	3.07	83	249	3.00	30	81	2.70	83	171	2.06	113	252	2.23	416	644	1.55	3.1	22	7.08	419	666	1.59	459	759	1.65	156	408	2.62	615	1,167	1.90
1955	7	26	3.71	52	188	3.62	60	214	3.57	21	55	2.62	63	146	2.32	84	201	2.39	328	563	1.72	4.1	24	5.99	332	587	1.77	356	644	1.81	119	358	3.01	475	1,002	2.11
1960	3	14	4.67	69	280	4.06	72	294	4.08	22	62	2.82	91	227	2.49	113	289	2.56	362	635	1.75	ø	ø	ø	362	635	1.75	387	711	1.84	160	507	3.17	547	1,218	2.23
1965	6	35	5.83	130	417	3.21	136	452	3.32	158	487	3.08	101	245	2.43	259	732	2.83	12	90	7.50	ø	ø	ø	12	90	7.50	176	612	3.48	231	662	2.87	407	1,274	3.13
1970	32	118	3.69	149	620	4.16	181	738	4.08	240	495	2.06	203	522	2.57	443	1,017	2.30	ø	ø	ø	ø	ø	ø	ø	ø	ø	272	613	2.25	352	1,142	3.24	624	1,755	2.81
1971	73	276	3.78	93	376	4.04	166	652	3.93	250	500	2.00	124	334	2.69	374	834	2.23	ø	ø	ø	ø	ø	ø	ø	ø	ø	323	776	2.40	217	710	3.27	540	1,486	2.75
1972	46	130	2.83	124	591	4.77	170	721	4.24	214	736	3.44	29	230	7.93	243	966	3.98	ø	ø	ø	0.2	3.3	16.50	0.2	3.3	17.69	260	866	3.33	153	824	5.39	413	1,690	4.09
1973	57	185	3.25	150	679	4.53	207	864	4.17	230	639	2.78	ø	ø	ø	230	639	2.78	ø	ø	ø	2.2	6.7	3.05	2.2	6.7	3.00	287	824	2.87	152	686	4.51	439	1,510	3.44
1974	69	151	2.19	120	524	4.37	189	675	3.57	194	498	2.57	ø	ø	ø	194	498	2.57	ø	ø	ø	ø	ø	ø	ø	ø	ø	263	649	2.47	120	524	4.37	383	1,173	3.06
1975	130	392	3.02	191	904	4.73	321	1,297	4.04	180	581	3.23	ø	ø	ø	180	581	3.23	ø	ø	ø	ø	ø	ø	ø	ø	ø	310	973	3.14	191	904	4.73	501	1,877	3.75
1976	79	363	4.59	219	1,598	7.30	298	1,961	6.58	89	446	5.01	ø	ø	ø	89	446	5.01	ø	ø	ø	ø	ø	ø	ø	ø	ø	168	809	4.82	219	1,598	7.30	387	2,407	6.22
1977	132	678	5.14	106	865	8.16	238	1,543	6.48	133	972	7.31	80	560	7.00	213	1,532	7.19	ø	ø	ø	ø	ø	ø	ø	ø	ø	265	1,650	6.23	186	1,425	7.66	451	3,075	6.82
1978	121	714	5.90	147	1,211	8.24	268	1,925	7.18	128	961	7.51	96	750	7.81	224	1,711	7.64	ø	ø	ø	ø	ø	ø	ø	ø	ø	249	1,675	6.73	243	1,961	8.07	492	3,636	7.39
1979	125	792	6.34	157	1,417	9.03	282	2,209	7.83	172	1,289	7.49	98	830	8.47	270	2,119	7.85	ø	ø	ø	ø	ø	ø	ø	ø	ø	297	2,081	7.01	255	2,247	8.81	552	4,328	7.84
1980	99	860	8.69	157	1,672	10.67	256	2,532	9.89	101	749	7.42	125	1,115	8.92	226	1,864	8.25	ø	ø	ø	ø	ø	ø	ø	ø	ø	200	1,609	8.05	282	2,787	9.88	482	4,356	9.12
1981	97	954	9.84	181	2,054	11.35	278	3,008	10.82	72	614	8.53	117	1,170	10.00	189	1,783	9.44	ø	ø	ø	ø	ø	ø	ø	ø	ø	169	1,568	9.28	298	3,224	10.82	467	4,752	10.26
1982	98	1,081	11.03	176	2,273	12.91	274	3,354	12.24	10	167	16.70	128	1,651	12.90	138	1,818	13.17	ø	ø	ø	ø	ø	ø	ø	ø	ø	108	1,248	11.56	304	3,924	12.91	412	5,172	12.55
1983	104	1,225	11.78	176	2,167	12.31	280	3,392	12.11	55	232	4.22	106	1,360	12.83	161	1,592	9.89	ø	ø	ø	ø	ø	ø	ø	ø	ø	159	1,457	9.16	282	3,527	12.51	441	4,984	11.30

NOTE: Due to rounding, components may not equal "Total" when added.

On the 1920 to 1982 production (shipments) trend line for New Brunswick, the year to year growth in order to meet demand has been 11,946 tonnes per year. This amounts to an annual increase of 1.9% on the 1982 trend-line production of 619,665 tonnes. If the long term trend continues to be followed, another 50 years will pass before sustained annual production doubles to approximately 1,200,000 tonnes. If a 200 mw circulating fluidized bed plant were built in New Brunswick and operated to meet anticipated emission standards, using coal, oil shale and limestone, it could require only 120,000 tonnes of limestone annually.[3] Thus, the limestone required for this purpose or to modify an existing thermal plant to meet the same emission standards could easily be produced by the current quarry operators.

Another prospective emission control market of potentially large size is oil-fired electricity generating plants, such as the ones at Coleson Cove and Dalhousie, should they switch to consumption of a lower cost high sulphur fuel as oil prices again rise. The potential for this will be investigated under a $13.4 million test burning of Venezuelan Orinoco fuel scheduled to start in September 1987 and completion by March 1988. Under an agreement with Petroleos de Venezuela, N.B. Power will do a 3,200 hour test burn of emulsified Orinoco fuel containing approximately 2.85% sulphur at the 100 mw Dalhousie I unit. It is anticipated that 21,775 tonnes of finely pulverized limestone (M. Gardiner, NBEPC) will be required to reduce sulphur emissions by the target amount of 25 to 50%. Should the testing yield positive results and should the cost advantage be sufficient, it is apparent that the Coleson Cove generating plant would require 300,000-500,000 tons of pulverized limestone annually to operate on Orinoco fuel.

One other prospective market for 750,000 tonnes of dolomite per year was identified in Quebec for production of magnesium. Whether a New Brunswick producer supplies this market depends on whether the New Brunswick material can be competitive in quality and price. Any competitive quarry will be at or near tidewater. In addition to this prospective market,

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3 N.B. Power internal report, 1985

there are prospective backhaul opportunities to the southeast United States, particularly on boats bringing phosphate rock to Belledune Fertilizer Limited. The United States coastal sunbelt area to which these boats return is one of the primary target markets for limestone from a 2-4 million tonne per annum operation proposed for Bay St. George, Newfoundland by Explaura Holdings PCL (Industrial Minerals, April 1986).

The past decade of declining production is part of the third such major cycle since 1954. (Figures 1 and 2). From trough to trough, each cycle has been longer - the first from 1954 to 1959 with the peak in 1956, the second from 1959 to 1970, with the peak in 1962 and the third from 1970 to 1985 (?) with the peak in 1975. The first and last peaks clearly reflect periods of significant construction activity in the province (Figure 2). The prospective markets discussed in the preceding paragraphs are not anticipated to contribute to any notable change in the slope of the long term treadline over the coming decade because there will not be a repeat of the frequency of construction activity peaks.

Bagged hydrated lime is one product for which regional demand is supplied entirely from Quebec. This demand is reaching the point where the local producer should be able to justify entering the market. Furthermore, Brunswick Mining and Smelting Corporation Limited and Heath Steele Mines Limited began making about 65% of their hydrated lime in 1986, thus replacing this portion of bulk hydrated lime markets with quicklime. This loss of 40-50% (± 17,000 tonnes) of Havelock's market for bulk hydrated lime may encourage the company to market bagged product if they are to contine utilizing their hydrating capability. The market for bagged hydrated lime is 4,000 tonnes per annum or less.

A product which has the potential for a competitively accessable market exceeding 100,000 tonnes per annum is precipitated calcium carbonate (PCC). This would be for use as a filler by the paper industry, displacing clay fillers. The principal target market would be the quality paper producers of Maine. At least some paper manufacturers could be convinced to switch to PCC, however, any lime company planning to develop this market should be prepared to incur a fairly significant cost. First, testing would be required to determine whether a quality PCC can be produced from New Brunswick quicklime. Secondly, the lime producer would have

to be prepared to invest in PCC capacity before the market could be developed.

Value of Production

Figure 3 and Table III show the trend in value and quantity of New Brunswick limestone production. On a constant 1983 dollar basis using the gross national expenditure implicit price index, the value of 1975 production would be $5,939,000, i.e., more than the actual 1983 value of $4,557,000. The 1975 record quantity of production, excluding for cement and lime manufacture, was 888,000 tonnes versus 444,000 in 1983. The greater differential between quantity than value for the years 1975 and 1983 in part is due to the fact that low unit value crushed stone for construction purposes amounted to 67% of the quantity in 1975 versus only 43% in 1983. It also in part is due to an apparent real increase in the selling price of chemical process stone and pulverized stone. In the case of chemical process stone, the 1975 price expressed in 1983 dollars was $6.60 per tonne versus an actual 1983 price of $12.99 per tonne. In the case of pulverized stone, the 1975 price expressed in 1983 dollars was $10.34 per tonne versus an actual 1983 price of $13.57 per tonne (see Table II for current dollar basis).

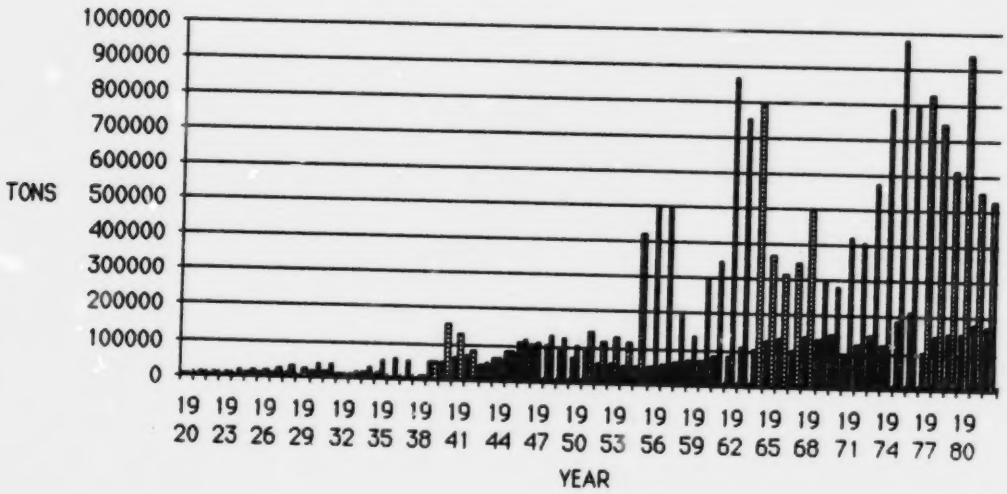
Producers and Supply

The five producers of limestone in New Brunswick are (Figure 4) Brookville Manufacturing Company Ltd., Canada Cement Lafarge Ltd., Elmtree Resources Ltd., Havelock Lime Works Ltd., and Upper Kent Lime Ltd.

1) Brookville Manufacturing Company Ltd. at Brookville, East Saint John, is a producer of agricultural dolomitic limestone, fertilizer filler, roofing granules, concrete and asphalt aggregate, driveway aggregate, road metal and hardpack road sub base. Annual production over the past 5 years has been in the 200,000 - 225,000 tonne range. A decade ago, it ranged up to 500,000 tonnes. Crushing and milling (pulverizing) capacity are approximately 250 and 90 tonnes per hour, respectively. On an 8-hour day and 350-day year basis, this would allow production of more than three times the current output of crushed and milled products. Reserves are sufficient for more than 10 years at the current

Figure 3

QUANTITY OF PULVERIZED STONE PRODUCTION IN NEW BRUNSWICK COMPARED WITH TOTAL LIMESTONE PRODUCTION (Statistics Canada Catalogue 26-225 & Predecessors)



VALUE OF PULVERIZED STONE PRODUCTION IN NEW BRUNSWICK COMPARED WITH VALUE OF TOTAL LIMESTONE PRODUCTION (Statistics Canada Catalogue 26-225 & Predecessors)

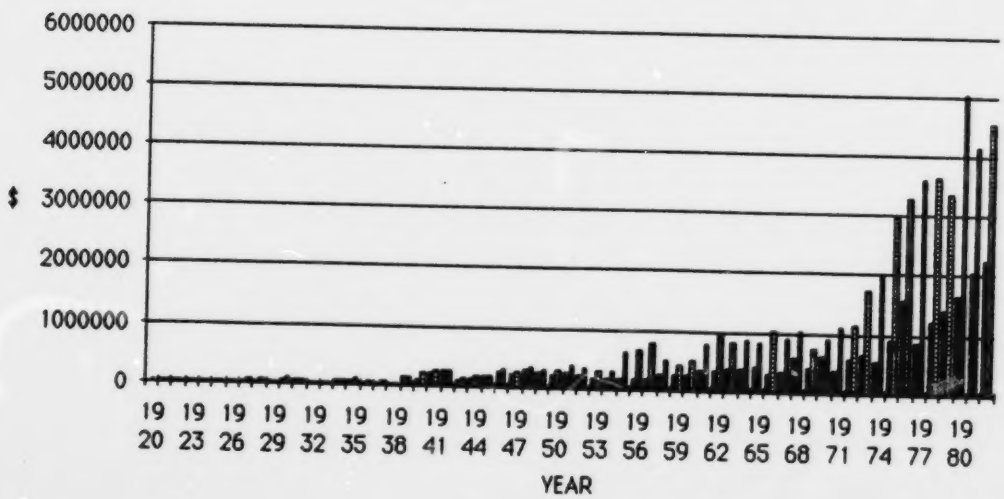


Table III

Value of Limestone Production (Shipments) in New Brunswick - Excluding Stone for Production of Cement and Lime, but Including Marl, Dolomite and Marble

Year	Current Dollars	Year	Current Dollars
1920	$ 16,720	1959	$ 425,593
1921	31,998	1960	495,981
1922	30,000	1961	793,465
1923	21,981	1962	939,619
1924	33,299	1963	828,740
1925	35,012	1964	877,402
1926	30,722	1965	821,743
1927	56,146	1966	1,019,000
1928	57,650	1967	916,000
1929	33,360	1968	1,040,000
1930	97,841	1969	750,000
1931	73,398	1970	912,000
1932	31,554	1971	1,097,000
1933	41,904	1972	1,121,000
1934	78,441	1973	1,734,000
1935	86,001	1974	2,004,000
1936	55,564	1975	2,995,000
1937	55,600	1976	3,289,000
1938	19,855	1977	3,600,000
1939	142,927	1978	3,651,000
1940	206,916	1979	3,381,000
1941	274,000	1980	5,040,000
1942	281,296	1981	4,192,000
1943	128,915	1982	4,585,000
1944	165,258	1983	4,557,000
1945	198,326		
1946	283,301		
1947	262,820	TOTAL	58,726,756
1948	335,519		
1949	305,357		
1950	289,422		
1951	384,259		
1952	337,988		
1953	316,397		
1954	299,038		
1955	610,226		
1956	655,575		
1957	793,349		
1958	503,278		

Source: Statistics Canada Catalogue 26-225 and predecessors; 1921-2 estimated.

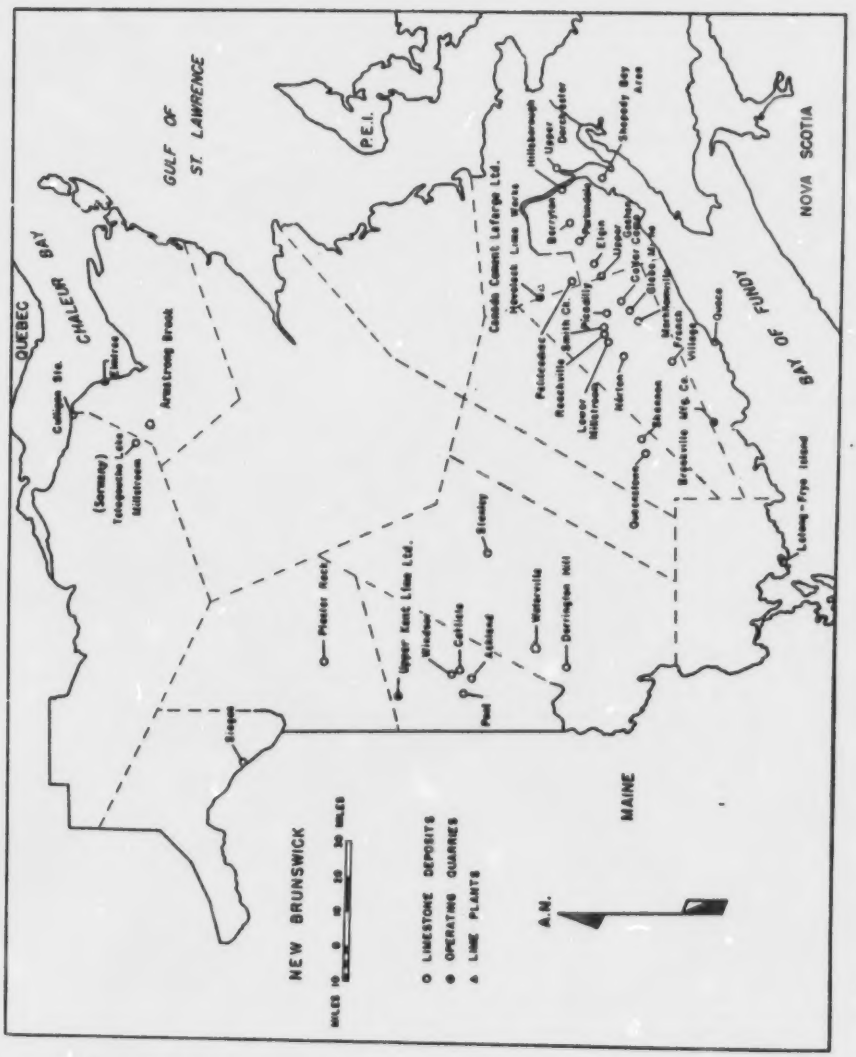


FIGURE 4 Outline map, location of major limestone occurrence, quarries and plants in New Brunswick

rate of production. This reserve horizon has been maintained for many years and, given the geological environment of the immediate vicinity, supply in both a capacity sense and resource availability sense will be adequate to meet any demand likely to materialize over the next several decades.

2) Havelock Lime Works Ltd. at Havelock on the boundary between Kings and Westmorland Counties is a producer of agricultural calcitic and magnesium limestone, industrial and chemical process stone, crushed stone for various aggregate uses and, through Havelock Processing Ltd., calcined and hydrated lime. Annual quarry output and crusher feed is usually within 10% of 300,000 tonnes. Capacity for crushing is approximately 280 tonnes per hour, for pulverizing is approximately 45 tonnes per hour and, for calcining, capacity is between 175 and 200 tonnes per day. Although reserves accessible by surface quarrying at the company's Samphill quarry are limited, an agreement which will assure availability of large high quality reserves was concluded with Canada Cement early in 1986. Thus, except for lime, capacity is considerably in excess of current or foreseeable demand. In the case of lime, a Fuller annular shaft kiln is being installed. It will have a capacity of 300 tonnes of product per day after installation is complete in late 1987.

3) Canada Cement Lafarge Ltd. has a quarry on Highway 880 several kilometers east of Havelock. It has been a producer of cement at this site since 1952, however, the prominence of the plant as a Maritime producer has diminished since 1982. Although the plant has continued to grind clinker from Canada Cement's Brookfield plant in Nova Scotia, production of cement from the local raw material essentially has been limited to fulfilling market requirements for oil well and other specialty cements. Thus, limestone quarried for cement production is now 60,000 tonnes per annum or less compared with more than 300,000 tonnes in each of the 5 years preceding 1982. In addition, 40-250,000 tonnes of limestone are quarried annually for Havelock Lime Works Ltd. and additional amounts periodically for the Canfarge ready-mix division, Permanent Concrete. For example, Permanent set up and crushed in 1983 and again will be crushing about 200,000 tonnes of limestone during the summer of 1986 to provide a stockpile for use during the

next 2-3 years. The Canada Cement Lafarge plant has a reported clinker production capacity of 300,000 tonnes per year and a grinding capacity of 315,000 tonnes. Crushing capacity is 450 tonnes per hour.

4) Elmtree Resources Ltd. operates a quarry and crushing-pulverizing plant about 20 kilometers north of Bathurst near the village of Petit Rocher, Gloucester County. Annual production of 50-60,000 tonnes is primarily sold to the lead smelter at Belledune as flux and, to a lesser extent, to other buyers as aggregate, fertilizer filler and agricultural limestone. Crushing and pulverizing capacity are sufficient to supply more than four times the current annual demand. Reserves in the explored area of the present quarry are sufficient for at least 10 years at the current rate of production, but two other deposits being evaluated have inferred reserves sufficient for more than 100 years.

5) Upper Kent Lime Ltd. is a producer of marl from the bed of a small drained lake (White Mud Lake) at Maplehurst near upper Kent in Carleton County. Annual sales to the region's farmers are in the 1,000 - 1,500 tonne range.

Reserves

Although it is not the purpose of this report to examine or verify the reserves of limestone in New Brunswick, it is apparent that overall reserves will be adequate to meet likely demand for the next 50 years and beyond. The centrally located Canada Cement property at Havelock alone contains reserves of high grade limestone (53% CaO_3) "estimated between 75 and 100 million tonnes."[4] In addition, the other main producers (Brookville, Elmtree and Havelock) are estimated to have

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4. Information Circular 85-2, New Brunswick's Mineral Industry, 1984, edited by Barbara M. W. Carroll, Mineral Resources Division, Department of Natural Resources.

reserves adequate for at least 10 years at their currently operating quarries and all have other properties with significant additional, but not fully quantified, reserves. Even though the New Brunswick reserves will be adequate to meet regional demand, production capacity periodically will not be adequate to supply certain products until the market size has grown enough to justify investment in facilities to manufacture these products competitively.

CHEMICAL PROCESS STONE

Markets

In the Atlantic Region the principal markets for chemical process stone are the Belledune lead smelter of Brunswick Mining and Smelting Corporation Ltd., Miramichi Pulp and Paper Ltd., (Newcastle), St. Anne Nackawic Pulp and Paper Company Ltd., (Nackawic), Sysco (Sydney, N.S.) and Scott Maritimes Limited (New Glasgow, N.S.). The total annual market is estimated to be divided as follows: pulp and paper up to 30,000 tonnes; glass manufacture up to 10,000 tonnes; the non-ferrous (lead) smelter approximately 45,000 tonnes; and the iron and steel plant 85,000 tonnes. Individual identified buyers are listed in Table IV together with relevant information on source of supply, specifications and changing requirements.

The most probable prospective chemical process stone markets are as a sulphur captor in coal-fired electricity generating plants, and as a flux in a possible antimony smelter. A more speculative prospective market is a commercial metals refinery utilizing the RPC S-R-L Process currently being piloted near Chatham. In total, these markets could create a requirement for as much as 500,000 tonnes of limestone sometime within the next 10 to 20 years.

TABLE IV

IDENTIFIED CHEMICAL PROCESS STONE MARKETS AND PROSPECTIVE MARKETS

USER, PLANT LOCATION AND CONTACT	ANNUAL CONSUMPTION	CONSUMPTION GROWING OR DECLINING	SUPPLIER(S)	SPECIFICATIONS	OTHER
	(tonnes/year)				
1. Brunswick Mining and Smelting Corp. Ltd. (Smelting Division) Belledune, Gloucester County N. B. E0B 1G0 M. D. Street, Manager (506) 522-2100	45,000	Static	Elmtree Resources has been supplier for the past 6 years and Havelock Lime Works, the previous supplier, is a prospective competitor.	- less than ¼" or 0.635 cm preferable. - approximately 50-53% CaO in material currently being used and there are no rigid specifications.	- serves as a flux
2. Miramichi Pulp & Paper Ltd. (formerly Boise Cascade and includes facilities which were owned by Acadia Forest Products) Newcastle, N. B. E1V 3M7 E. J. Napke, Purchasing Agent (506) 622-2252	14,000	Static	Havelock Not aware of any competitive alternative	- no issued specifications, but material supplied is adequate, i.e.,-3/4" + 1/4"	- company operates 2 kilns to make quicklime for reacting with the "black liquor" (waste $NaCO_3$ solution) to regenerate NaOH for reuse in the Sulphate Process for making 550 tpd of kraft product. - quicklime is purchased only when kilns are not operable, up to 5 truckloads/year.
3. St. Anne-Nackawic Pulp & Paper Company Ltd. P. O. Box 1000 Nackawic, York County N. B. E0H 1P0 Bill Graham, Purchasing Manager (506) 455-8821	8,400	Static	Havelock No competitor	- Havelock specifications acceptable but occasional shipment may be off. - St. Anne actual specifications are 50-51% CaO minimum, 0.6-0.7% MgO maximum and size 3/8" - 1¼". Material supplied is-3/4" + 1/4".	- company operates one kiln and purchases pebble quicklime only when kiln is not in operation (approximately 420 tonnes/year). - have looked at Carleton County limestones but none has proved satisfactory (Mg too high at Carlisle and Ca too low at others).
4. Domglas Inc. P. O. Box 1068 Moncton, Westmorland County, N. B. E1C 8P2 Bob Cann, Purchasing Manager	8-10,000	Static	Havelock No competitive alternative	- 16-100 mesh and Havelock high calcium analysis is adequate. (See text for Domglas specifications - Warren Caseley (416) 823-3860).	- serves as flux
5. Consolidated Bathurst Inc. New Richmond, P. Q. Len Gallon (418) 392-4474	900	Static	Havelock	Not indicated	- used stone from a local quarry until encountered quality problems and since 1984-85 have purchased requirement from Havelock.

USER, PLANT LOCATION AND CONTACT	ANNUAL CONSUMPTION	CONSUMPTION GROWING OR DECLINING	SUPPLIER(S)	SPECIFICATIONS	OTHER
	(Tonnes/year)				
6. Scott Maritimes Ltd. New Glasgow, N. S. "Jim" Horton (902) 752-8461	2,500	Static	Local quarry owned by Havelock	+ 3/4" - 3"	
7. Sysco (Sydney Steel Co.) Sydney, N. S. Harvey McLeod, Assistant to President (902) 539-6298	Up to 60,000 dolomite Up to 25,000 limestone	Until 1990 or shortly thereafter	Local quarries (company owned)	Not indicated	- a firm decision has been made to convert to electric arc furnaces by 1990 and will change the requirement to about 25,000 tpy quicklime instead of limestone and dolomite. - the company has a 300 tpd calcimatic kiln and is currently comparing the economics of purchasing quicklime.
8. Durham Resources Inc. Prince William York County, N. B. E0H 1S0 "Vic" Hendricksen, Mill Superintendent (506) 454-9761	1,500	Prospective consumer after 1986-7	N/A	Not indicated	- studying feasibility of building an antimony smelter which would require limestone as a flux.
9. N. B. Power Chatham, N. B. Carl Flynn (506) 458-4444	2,500 - 10,000	Trial Operation starting 1986	Not finalized	- 0.5-1 MM average particle size. - high reactivity and capacity to capture sulphur, but actual specifications will depend on tests currently being done on various N. B. limestones	- duration of requirement for limestone and whether a larger scale fluidized-bed plant is built will depend on results of the pilot operation. 200 MW plant might require 150,000 tonnes.

USER, PLANT LOCATION AND CONTACT	ANNUAL CONSUMPTION (Tonnes/year)	CONSUMPTION GROWING OR DECLINING	SUPPLIER(S)	SPECIFICATIONS	OTHER
10. Dept. of Natural Defence/ CANMET Summerside, P.E.I. George Lee, CANMET (613) 996-4570	±2,000	Static	Havelock	- 1/8" average particle size.	- fluid bed electricity generating and heating facility utilizing 10-20,000 tpy of N. S. coal containing up to 5% sulphur.
11. Enhanced Recovery Systems Ltd. Chatham (Morrison's Cove) N. B. (506) 773-7496	2 - 300	Trial operation, 1986	Havelock	- 100 mesh, greater than 90% $CaCO_3$ and less than 0.77% Mg.	- required to buffer first stage leach solution and for producing calcium plumbate in brine leach phase of RPC S-R-L Process. - full scale plant producing 100,000 tpy zinc could require 200,000 tpy limestone, depending on the feed quality. - Canada/N. B. pilot plant funding will last to Sept. 1986, after which further limestone requirements will depend on results of current tests and investment climate for metal and sulphuric acid producers.
12. N.B. Power Dalhousie, N.B. M. Gardiner (506) 454-4444	±22,000	Trial operation 1987-8	Not finalized, but would like to test various Limestones.	- Sieve # / Opening (mm): 100 / 0.15; 200 / 0.075; 270 / 0.053; 325 / 0.045 % Passing / % Retained: 97 / 3; 88 / 9; 80 / 8; 77 / 3 - 96% $CaCO_3$ desireable, but reactivity most important.	- for 3,200 hour test burning of high sulphur (±2.8% in emulsion) Venezuelan Orinoco heavy oil at 10 mw Dalhousie I unit commencing Sept 1987.

Table V presents historical shipments of chemical process stone by New Brunswick producers. There is no subdivision of the shipments according to use since 1973, however it is apparent that market growth since that time has resulted from increased usage by the lead smelter and glass plant (Domglas) as well as the emergence of new miscellaneous users such as the Summerside facility. The limestone listed under the heading "Flux in Iron and Steel Furnaces" after 1969 by Statistics Canada is suspected to be flux for non ferrous smelters.

Specifications

The Belledune lead smelter is the largest single New Brunswick consumer of chemical process stone. It serves as a flux and facilitates the refining of lead by entrapping silica, alumina, some sulphur and other impurities in slag. The specifications for limestone flux at Belledune are not as rigid as for many other smelting/refining processes. Material of minus 14 millimeters and with 50-53% CaO is currently used.

Several kraft (Sulphate Process) pulp mills purchase limestone for calcining to quicklime in their own kilns. Miramichi Pulp and Paper Ltd. has two lime kilns - a 7' x 200' Traylor and a 10½' x 185' Schmidt. St. Anne-Nackawic Pulp and Paper Company Ltd. has one 10' x 250' F. L. Smidth kiln with 170 ton per day capacity. Quicklime is employed in the Sulphate Process to causticize the waste sodium carbonate solution and regenerate sodium hydroxide for reuse in the process. The calcium carbonate sludge is washed, filtered and calcined for reuse. Specifications for limestone are not extremely rigid for these plants, however it must calcine well. CaO content of 50-53% and a maximum of 0.6 - 0.7% MgO is typical. Size ideally should be in the 3/8" - 1¼" range but Havelock supplies material in the ¼" - ¾" range.

TABLE V

HISTORY OF CHEMICAL PROCESS STONE SHIPMENTS FROM NEW BRUNSWICK PRODUCERS

YEAR	FLUX IN IRON & STEEL FURNACES		GLASS FACTORIES		PULP & PAPER MILLS			SUGAR REFINERIES			OTHER			TOTAL		
	Tons	$	Tons	$	Tons	$	$/T	Tons	$	$/T	Tons	$	$/T	Tons	$	$/T
1924														11,732	24,556	2.09
1925														14,000	25,800	1.84
1926														13,800	25,580	1.85
1927														14,100	23,535	1.81
1928														15,017	23,525	1.57
1929														17,580	28,600	1.63
1930					21,719	42,144	1.94	50	300	6.00				21,769	42,444	1.95
1931					19,865	26,784	1.35	15	120	8.00						
1932					-	-	-	-	-	-						
1933					3,892	5,051	1.30									
1934					3,807	5,502	1.45	50	185	3.70						
1935					4,483	6,500	1.45	75	300	4.00				4,558	6,800	1.49[1]
1936					4,668	6,769	1.45	52	225	4.33						
1937					6,552	10,862	1.66	40	190	4.75						
1938					1,940	3,295	1.70	90	360	4.00						
1939					2,265	3,850	1.70	75	300	4.00						
1940					5,500	9,900	1.80	20	80	4.00				5,520	9,980	1.81
1941					5,670	10,500	1.85	30	120	4.00						
1942	6	9			6,339	14,034	2.21	28	133	4.75						
1943	6	13			4,270	7,902	1.85									
1944	57	110			4,188	7,748	1.85									
1945					3,077	5,693	1.85	11	52	4.73				3,088	5,745	1.86
1946	6	9			4,829	10,000	2.07	12	60	5.00						
1947					5,320	11,966	2.25									
1948					6,500	14,625	2.25									
1949					4,001	9,462	2.36	31	176	5.68						
1950	93	336			12,378	33,729	2.72	22	125	5.68				12,493	34,190	2.74
1951	54	162			7,514	20,710	2.76	56	319	5.70						
1952	89	327			6,396	20,467	3.20	103	721	7.00						
1953					7,835	26,037	3.32	104	600	5.77						
1954					7,833	27,416	3.50	100	700	7.00						
1955	84	252			7,071	24,754	3.50	118	826	7.00				7,273	25,832	3.55
1956	67	201			172	602	3.50	138	966	7.00						
1957	111	333			593	2,076	3.50	72	504	7.00						
1958	126	378			532	1,862	3.50	24	168	7.00						
1959	186	775			380	1,554	4.09	32	224	7.00						
1960	105	405			2,542	13,393	5.27	24	168	7.00				2,671	13,966	5.23
1961	242	1,307			7,715	40,036	5.19									
1962	192	1,149			7,712	47,259	6.13	44	396	9.00						
1963	225	1,350			4,987	29,212	5.86	56	504	9.00						

1. Figures totalled for every fifth year from 1930 to 1969.

YEAR	FLUX IN IRON & STEEL FURNACES		GLASS FACTORIES		PULP & PAPER MILLS			SUGAR REFINERIES			OTHER			TOTAL		
	Tons	$	Tons	$	Tons	$	$/T	Tons	$	$/T	Tons	$	$/T	Tons	$	$/T
1964																
1965	276	1,768			4,605	25,420	5.52				967	7,675	7.94	5,848	34,863	5.96
1966	206,770	690,921			5,781	36,072	6.24									
1967	300	1,920			4,960	31,233	6.30									
1968	295	1,888			11,207	41,983	3.75									
1969	340	1,000	1,001	3,391	28,507	58,790	2.06	427	1,616	3.78				30,275	64,979	2.14
1970	8,134	36,949	3,022	15,865	21,004	65,211	3.10							32,160	118,025	3.67
1971	12,428	55,463			21,483	84,681	3.94				39,127[2]	135,609[2]	3.47	73,038	275,753	3.78
1972	12,979	33,405	5,120	25,000	27,758	71,610	2.58							45,857	120,015	2.84
1973	17,273	25,941	6,044	48,352	30,016	79,352	2.64				2,971	31,768	8.00	57,304	185,413	3.24
1974	N/A		N/A			N/A			N/A			N/A		68,989	150,498	2.18
1975	N/A		N/A			N/A			N/A			N/A		129,914	392,251	3.02
1976	N/A		N/A			N/A			N/A			N/A		79,356[3]	362,890[3]	4.57
1977	N/A		N/A			N/A			N/A			N/A		132,214[3]	677,701[3]	5.13
1978	N/A		N/A			N/A			N/A			N/A		121,000	714,000	5.90
1979	N/A		N/A			N/A			N/A			N/A		125,000	792,000	6.34
1980	N/A		N/A			N/A			N/A			N/A		99,000	860,000	8.69
1981	N/A		N/A			N/A			N/A			N/A		97,000	954,000	9.84
1982	N/A		N/A			N/A			N/A			N/A		98,000	1,081,000	11.03
1983	N/A		N/A			N/A			N/A			N/A		104,000	1,225,000	11.78

2. Shipped to foreign lime kilns.
3. Figures rounded to nearest 1000 for 1978 and subsequent years.

SOURCES: Statistics Canada Catalogue 26-225 and predecessor catalogues.

The glass plant of Domglas, Inc. at Scoudouc near Moncton is the third largest consumer of New Brunswick limestone as a chemical process ingredient. Limestone fluxes the silica sand forming chemically-fused calcium silicates, of which glass if primarily composed. The company specifications are listed below. Havelock Lime Works produces a 16-100 mesh fraction of high calcium material for Domglas.

Domglas Limestone Specifications
(J. W. Casely, 416-823-3860)

Chemical	Physical
SiO_2 - constant $\pm$ 0.15%; 0.75% max.	Cumulative % retained
Fe_2O_3 - 0.085% max.	on U.S. Standard Screen
Al_2O_3 - constant $\pm$ 0.15%; 0.3% max.	
CaO + MgO - 55% minimum	#14 - nil
MgO - constant $\pm$ 0.15%; 1.3% max.	#16 - trace
SO_3 - 0.25% max.	#20 - 2% max.
Cr_2O_3 - nil	#30 - 15% max.
Co_3O_4 - nil	
Cu - 2 ppm max.	and % passing.
Ni - 2 ppm max.	
H_2O - 0.2% max.	#100 - 15% max.
Organics - 0.01% max.	#200 - 3% max.

These specifications are less demanding than specified by Boynton (1980, p. 107).

Specifications for the suggested prospective markets will depend on results of tests on alternative limestones to determine reactivity and appropriate size fraction for the particular use. Furthermore, the transportation cost of alternative limestones with different suitability may influence final specifications.

Prices

New Brunswick producers have no published list prices for industrial or chemical process stone. The average f.o.b. sales value in 1983 was $12.99 per tonne, calculated by dividing Statistics Canada's value of chemical process stone shipments by quantity. This is a hybrid value, because some process stone is characterized by larger volume and less rigid specifications than other material. Hence, it sells at a lower price. In 1985, the f.o.b. price for at least 85% of process stone was in the $9 to $14 per tonnage range.

The average price of chemical process stone has outpaced the rate of inflation since 1975. The 1975 current price of $4.44 per tonne increased to $12.99 per tonne in 1983, however it would have increased to only $6.60 per tonne by 1983 had it merely kept pace with inflation measured by the gross national expenditure implicit price index. This differential is difficult to explain. Perhaps it is the consequence of a market characterized by a small number of moderate-sized consumers virtually captive to the nearest producer of adequate material because of transportation cost. Also, the rapid increase of fuel prices during this period were reflected in crushing, grinding, sizing and transportation costs. Undoubtedly, these factors in part are responsible as is the fact that process stone prices had not kept pace with inflation or had behaved erratically prior to 1975.

PULVERIZED STONE

"Pulverized Stone" is Statistics Canada's designation for limestone and other stone products used as whiting (or filler), asphalt filler, for dusting coal mines, and, for agriculture purposes in soil improvement, as a mineral supplement in animal feed and as a filler in fertilizer mixtures. Although poultry grit and the material used in glass making are also products of the milling or pulverizing process, at least in New Brunswick limestone plants, they are included by Statistics Canada under the "crushed stone" and "chemical and metallurgical" categories, respectively. For consistency, this report will adhere to the Statistics Canada usage designations under the headings "chemical and metallurgical" (chemical process stone) and "pulverized" stone, but with the addition of "poultry grit" in this section under the heading "pulverized stone" instead of "crushed stone". This is because poultry grit should be included with other products marketed for agriculture use and because it is a product of the pulverization process.

From 1920 through 1985, total estimated production of pulverized limestone has exceeded 4.8 million tonnes with sales value of slightly over $30 million. This compares with total limestone production, excluding for cement and lime, of approximately 17 million tonnes with sales value approaching $70 million. Table VI and Figure 5 depict historical production and the relationship between pulverized and total limestone production. The long term trend line shows an annual production increment of 2,572 tonnes. On 1981 trend line production of 147,173 tons, this increment is 1.7 percent.

TABLE VI

SALES OF NEW BRUNSWICK PULVERIZED STONE PRODUCTION, BY MARKET

YEAR	ASPHALT		COAL MINES/OTHER		AG & FERTILIZER		POULTRY GRIT		TOTAL	
	tons	$	tons	$	tons	$	tons	$	tons	$
1920	-	-	-	-	589	-	-	-	589	-
1921	-	-	-	-	6,666	-	-	-	6,666	-
1922	-	-	-	-	5,710	-	-	-	5,710	-
1923	-	-	-	-	3,196	-	-	-	3,196	-
1924	-	-	-	-	4,331	-	-	-	4,331	-
1925	-	-	-	-	8,679	-	-	-	8,679	-
1926	-	-	-	-	8,646	-	2	18	8,648	-
1927	-	-	-	-	10,029	31,199	23	197	10,052	31,396
1928	-	-	-	-	9,415	28,245	-	-	9,415	28,245
1929	-	-	-	-	2,130	4,260	-	-	2,130	4,260
1930	-	-	-	-	18,493	55,397	-	-	18,493	55,397
1931	-	-	-	-	15,498	46,494	-	-	15,498	46,494
1932	-	-	-	-	9,864	30,458	-	-	9,864	30,458
1933	-	-	-	-	10,350	36,649	20	204	10,370	33,853
1934	318	1,273	-	-	19,348	60,958	12	120	19,678	62,351
1935	-	-	-	-	14,500	45,300	-	-	14,500	43,500
1936	-	-	-	-	5,300	17,500	-	-	5,300	17,500
1937	-	-	-	-	4,368	15,600	-	-	4,368	15,600
1938	-	-	-	-	5,955	16,200	-	-	5,955	16,200
1939	-	-	-	-	48,453	136,715	31	310	48,484	137,025
1940	421	1,473	-	-	47,941	109,673	50	500	48,412	111,646
1941	-	-	-	-	60,545	213,700	74	740	60,619	214,440
1942	-	-	-	-	71,025	261,664	-	-	71,025	261,664
1943	-	-	-	-	46,678	120,911	-	-	46,678	120,911
1944	-	-	-	-	62,467	157,353	-	-	62,467	157,353
1945	-	-	-	-	81,319	192,400	-	-	81,319	192,400
1946	-	-	-	-	107,135	266,301	-	-	107,135	266,301
1947	539	2,695	-	-	99,824	235,115	-	-	100,363	237,810
1948	342	1,710	-	-	106,341	281,310	-	-	106,683	283,020
1949	523	1,515	-	-	94,225	247,322	-	-	94,748	248,837
1950	600	4,400	-	-	69,799	210,471	-	-	70,399	214,871
1951	861	3,188	-	-	94,503	278,014	-	-	95,364	281,202
1952	486	3,402	-	-	54,251	224,034	-	-	54,737	227,436
1953	1,243	8,701	-	-	53,158	183,838	-	-	54,401	192,539
1954	1,561	10,927	-	-	51,005	175,760	-	-	52,566	186,687
1955	1,909	12,201	-	-	50,482	175,726	-	-	52,391	187,927
1956	1,703	9,537	-	-	46,413	169,880	1,500	22,000	49,616	201,417
1957	1,624	9,094	-	-	52,269	185,996	1,677	12,870	55,570	207,960
1958	1,736	10,286	-	-	64,245	245,164	2,497	39,764	68,478	295,214
1959	1,632	8,976	-	-	71,129	272,026	3,141	52,103	75,902	333,105
1960	1,467	8,988	-	-	66,991	271,301	3,299	52,778	71,757	333,067
1961	1,143	9,144	-	-	82,395	317,308	4,021	54,924	87,559	381,376
1962	983	7,864	-	-	81,875	327,079	1,044	5,274	83,902	340,217
1963	22,260	19,890	-	-	88,307	368,309	870	4,740	111,437	392,939
1964	961	1,242	-	-	101,456	368,572	814	13,024	103,231	382,838
1965	99	644	19,957	22,537	109,943	393,570	789	16,263	130,788	433,014

cont'd.....**SALES OF NEW BRUNSWICK PULVERIZED STONE PRODUCTION, BY MARKET**

YEAR	ASPHALT		COAL MINES/OTHER		AG & FERTILIZER		POULTRY GRIT		TOTAL	
	tons	$	tons	$	tons	$	tons	$	tons	$
1966	62,500	50,000	5,231	30,766	67,850	219,075	-	-	135,581	299,841
1967	-	-	-	-	103,815	341,204	3,588	43,306	107,403	384,510
1968	12,000	34,800	-	-	134,127	538,637	7,269	65,684	153,396	639,121
1969	-	-	-	-	139,190	413,700	8,246	40,968	147,436	454,668
1970	11,955	26,900	-	-	136,742	592,658	1,425	9,262	150,122	628,820
1971	-	-	-	-	93,309	376,185	9,303	65,824	102,612	442,009
1972	9,349	10,751	1,325	13,250	113,010	566,687	9,695	58,170	133,379	648,858
1973	-	-	3,948	38,900	146,449	639,908	9,838	85,652	160,235	764,460
1974	na	na	na	na	na	na	na	na	120,285*	524,143*
1975	na	na	na	na	na	na	na	na	190,621	904,359
1976	na	na	na	na	na	na	na	na	218,639	1,597,651
1977	na	na	na	na	na	na	na	na	105,798	864,813
1978	na	na	na	na	na	na	na	na	147,000#	1,211,000#
1979	na	na	na	na	na	na	na	na	157,000	1,417,000
1980	na	na	na	na	na	na	na	na	157,000	1,672,000
1981	na	na	na	na	na	na	na	na	181,000	2,054,000
1982	na	na	na	na	na	na	na	na	176,000	2,273,000
1983	na	na	na	na	na	na	na	na	176,000	2,167,000

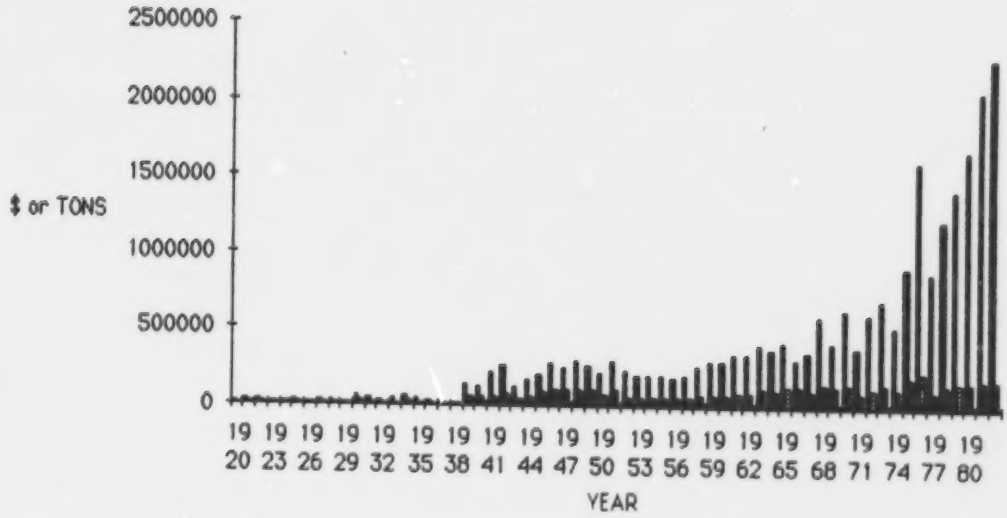
Sources: Statistics Canada Catalogue 26-225 and predecessor catalogues. Figures for early 1920's estimated or adjusted using data in annual reports of the New Brunswick Department of Agriculture. Limestone used in the production of cement and lime is excluded, but marl used for agriculture and dolomite are included.

* "TOTAL" for 1974 and subsequent years does not include poultry grit.
# Figures for 1978 and subsequent years are rounded to the nearest thousand.

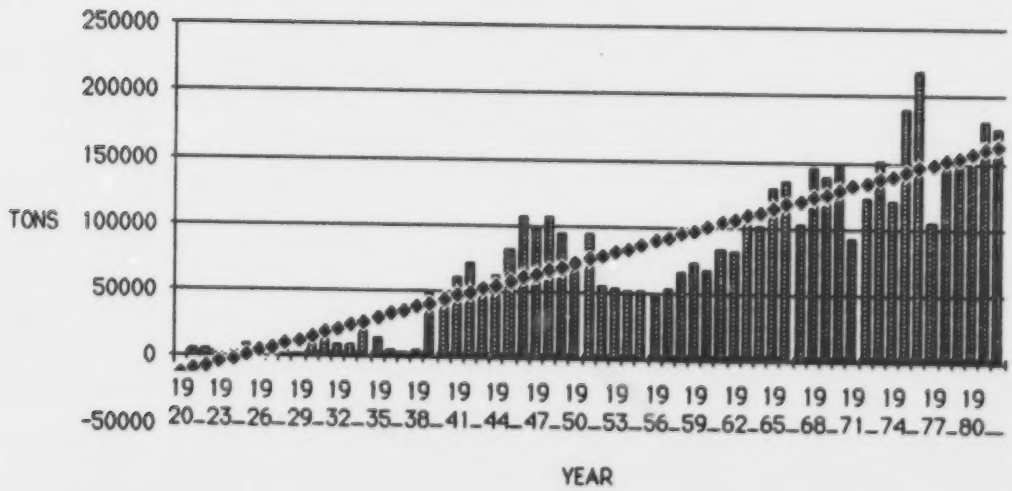
Graphs follow Statistics Canada practice and do not include poultry grit as pulverized stone.

FIGURE 5

PULVERIZED STONE PRODUCTION IN NEW BRUNSWICK (Statistics Canada Catalogue 26-225 & Predecessors)



PULVERIZED STONE PRODUCTION IN NEW BRUNSWICK WITH TREND LINE SUPERIMPOSED (Statistics Canada Catalogue 26-225 & Predecessors)



Agricultural Limestone and Fertilizer Filler

Agricultural limestone or "Aglime" production (sales) from New Brunswick slightly exceeded 133,000 tonnes in the 1985 calendar year and approximately 144,000 tonnes in 1984. In addition, some 29,000 tonnes[5] of material was produced each year for fertilizer filler, poultry grit and livestock mineral feed supplement. Less than 1,000 tonnes was sold as an additive in peat-based or other prepared growing media and in miscellaneous agricultural applications. In all, agricultural products have accounted for more than 95% of pulverized stone sold in 1985 and previous years, 26% of the estimated 623,000 tonnes of limestone used for all products in 1985 and some 35% of the estimated 457,000 tonnes of limestone used for all products except cement and lime. In terms of sales value, the agricultural and other pulverized stone products account for approximately 50% of all limestone, excluding that used in the manufacture of cement and lime. It is thus readily apparent that the New Brunswick limestone industry is more dependent on the health of the farming economy than on any other sector.

The 1985 agricultural product mix for New Brunswick limestone was divided approximately as follows:

Agricultural limestone and dolomite	133,000 tonnes
Fertilizer Filler	19,000 tonnes
Poultry grit, shell mix and animal feed supplement	10,000 tonnes
Peat and peat-soil mixes	1,000 tonnes
Total	163,000 tonnes

5. The total (133,000 + 29,000) of 162,000 tonnes differs from the total of 161,000 tonnes in Table I because an estimated 4,000 tonnes of poultry grit (shell mix) are included, but 3,000 tonnes of material for dusting coal mines and asphalt filler are excluded.

The geographical distribution of agricultural limestone and dolomite soil conditioning markets for New Brunswick producers in 1985 was essentially:

New Brunswick	71,000 tonnes
Prince Edward Island	48,000 tonnes
Maine	12,000 tonnes
Miscellaneous off the street sales	2,000 tonnes
Total	133,000 tonnes

New Brunswick, Nova Scotia and Prince Edward Island subsidize purchases of agricultural limestone and dolomite for soil conditioning. Maine does not. The Nova Scotia and New Brunswick subsidy programs offer assistance toward equalizing the transportation cost (and production cost in Nova Scotia) upon application by the farmer and purchase from a quarry operator approved by the respective Departments of Agriculture. Details of the New Brunswick and Nova Scotia assistance policies are in Appendix I together with a publication on the lime needs of Atlantic area soils. There are no sales of agricultural limestone by New Brunswick to Nova Scotia and vice versa because under the assistance programs, each province approves only producers within its own boundaries. Only New Brunswick includes gypsum (calcium sulphate) under its program.

The Prince Edward Island Department of Agriculture[6] pays $11.00 per tonne toward aglime purchases of any land owner involved in agriculture. Since Prince Edward Island has no limestone or dolomite deposits, this approach allows farmers to choose either a New Brunswick or Nova Scotia source. In the April 1, 1984 - March 31, 1985 period,

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6. Richard Vino, P.E.I. Department of Agriculture (902) 892-5465

assistance was paid on 30,620 tonnes from Havelock, 24,120 from Brookville and 11,814 from Mosher in Nova Scotia.

Figure 6 depicts the subsidized limestone production (shipments) in New Brunswick for New Brunswick farmers. The graph comparing this subsidized production with total "aglime" and fertilizer filler production (Statistics Canada and producer data) illustrates how much the market for aglime has grown outside New Brunswick relative to the in-province market. Until 1960 there was little, if any, "aglime" production beyond that which was subsidized by New Brunswick. Since 1960 the component not subsidized by New Brunswick has grown to the point where it exceeds the subsidized component. This, in part, is due to less of the material used in New Brunswick being subsidized. In the April 1, 1985 through January 10, 1986 period, 45,095 tonnes were subsidized by New Brunswick, however in-province shipments of producers for 1985 apparently totalled 71,000 tonnes. Likewise, for the April 1, 1984 through March 31, 1985 period subsidized shipments were 54,736 tonnes compared with total in-province shipments in the 75-85,000 tonne range.

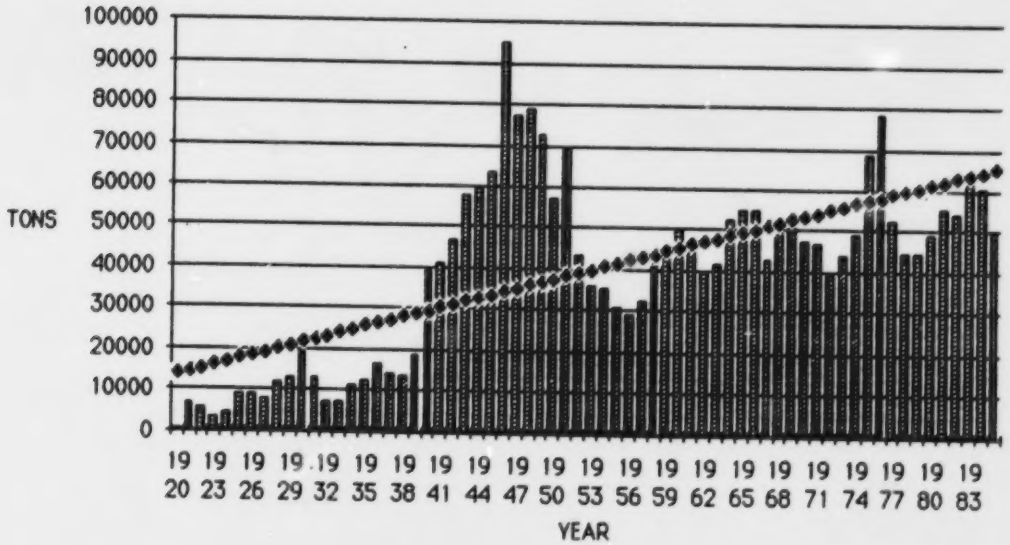
The New Brunswick subsidized shipments over the past two years were apportioned as follows:

	April 1/84 - March 31/85	April 1/85 - January 10/86
Havelock	30,615	27,150 tonnes
Brookville	23,191	16,985 tonnes
Elmtree	371	497 tonnes
Upper Kent	559	509 tonnes

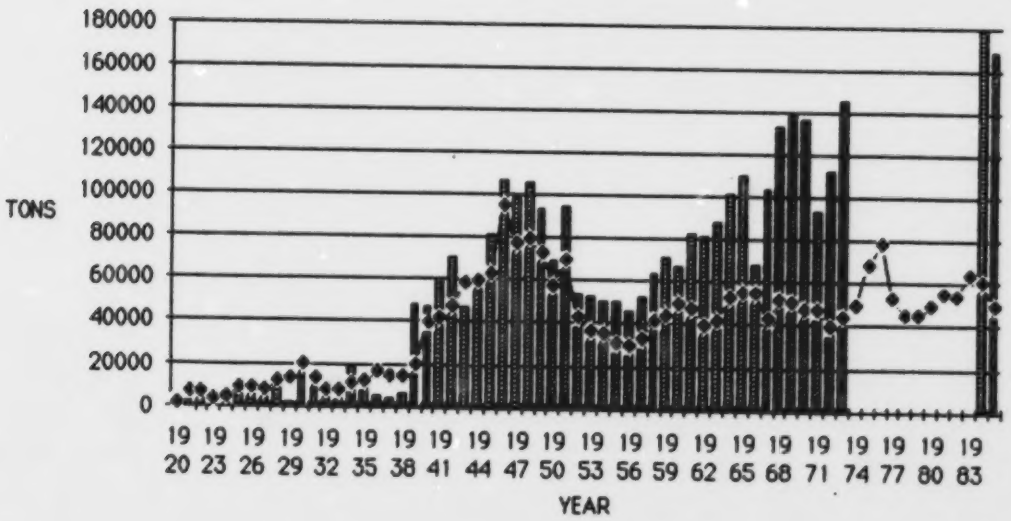
The statistics relative to the assistance program are dealt with in greater detail elsewhere in this report.

FIGURE 6

SUBSIDIZED AGLIME PRODUCTION IN N.B. - (NBDOA Ann. Repts. & Files)



SUBSIDIZED AGLIME COMPARED WITH TOTAL AGLIME AND FERTILIZER FILLER PRODUCTION IN NEW BRUNSWICK



In Maine, annual consumption of agricultural limestone is in the 65-85,000 tonne range. Of this, New Brunswick supplied about 12,000 tonnes in 1985, the Dragon Products Company supplied 25-30,000 tonnes from Thomaston where they also produce cement[7], Lane Construction Corporation supplied 13-14,000 tonnes from their Presque Isle quarry, Giles Lime Sales supplied 8,845 tonnes from a lake bed marl deposit at Fort Fairfield[8], and Le Carrier Temis supplied 5,440 tonnes from their Blue River quarry about 20 kilometers from Cabano in Quebec. Lee Lime of Adams, Massachusetts also supplies a small quantity of dolomitic lime, particularly for growing peas. According to New Brunswick producers, their Maine market has been declining since 1982. One producer noted that 1984 sales to Maine were down 25 percent from 1983 and a reasonable overall estimate is that sales to Maine have fallen from 12-15 percent of total sales of "aglime" in 1981 to about 9 percent in 1985. This is due to the economic plight of potatoe farmers as well as the decision of Lane Construction Corporation in the early 1980's to begin production of agricultural lime at their Presque Isle aggregate quarry. Although the material is low

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7. Clarence Burleson, Plant Manager, reports that his company ships an average of about 30,000 tons per year, mostly in bulk. They are considering production of grit for fertilizer filler, but not shell mix or chicken grit as the magnesium content is too high.

8. Mrs. Stanley Giles (207-774-0307) reported that annual production is in the 8-10,000 ton range from a drained lake (Nadeau Lake) on the East Limestone Road at Fort Fairfield. The marl is dug by crane, piled and screened. She reports a CaO equivalent of 30% and Ca content of 27% on a dry basis. The lime is sold only as part of a custom spread service. The operation began 18-20 years ago after Mr. Giles had worked at Moose Mountain Lime (now Upper Kent Lime Ltd.) and decided to develop the Nadeau Lake deposit.

grade[9], this is offset by a considerable transportation advantage as well as innovative pricing discounts for custom spreading the increased tonnage required to compensate for the lower lime content. Annual sales grew to the present range within two years of commencing production and have since remained steady.

Figure 7 depicts the historic production (shipments) of agricultural limestone and fertilizer filler in New Brunswick as well as the trend line based on production from 1920 to 1973 when Statistics Canada ceased reporting the components of pulverized stone production in New Brunswick. The annual increment of shipments is 2,149 tonnes. It appears that production since 1973 would have altered the trend line slope only marginally, if at all. On 1985 estimated production of 152,000 tonnes of "aglime" and fertilizer filler the 2,149 tonne annual increment represents 1.4 percent.

Figure 8 depicts value of New Brunswick "aglime" and fertilizer filler shipments in current dollars compared with quantity of shipments for the years 1920 through 1973. The trend line for shipment value is also shown.

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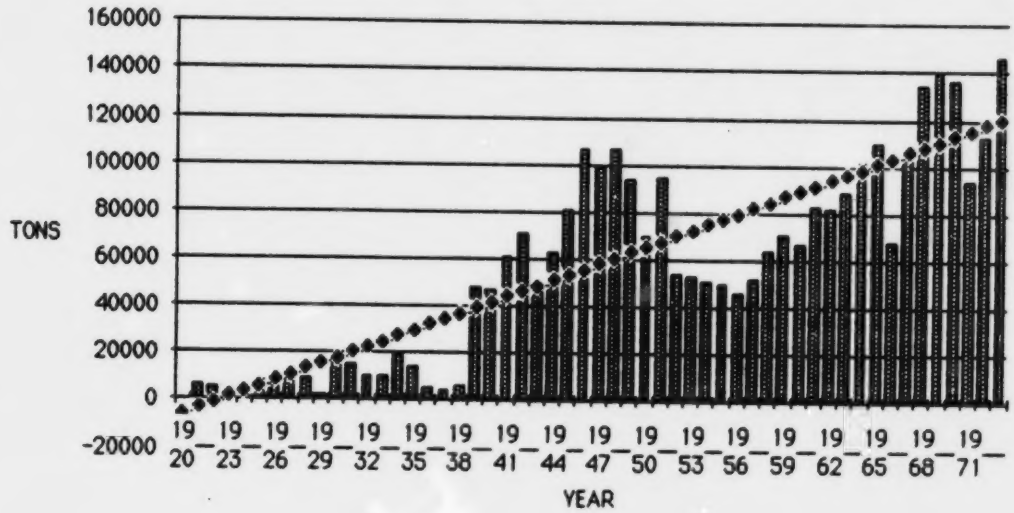
9. "Mike" Nelson (207-764-4137) of Lane Construction stated that the company guarantees a minimum of 22% calcium, however the material normally averages 27-28% Ca. Three representative samples tested in 1986 by the University of Maine Life Sciences and Agriculture Department at Orono contained 25.8% Ca, 27.9% Ca and 28.6% Ca. Of these, two contained 1.7% Mg and the third contained 2% Mg. Fineness determined in the 1986 test is 92.2% passing #20 sieve, 74.4% passing #40, 57.4% passing #60, 49.4% passing #80 and 43.4% passing #100.

Figure 7

AGLIME & FERTILIZER FILLER PRODUCTION IN N.B.
(Stats. Can. Cat. 26-225 & predecessors; 1984-5
from producers)



AGLIME & FERTILIZER FILLER PRODUCTION IN N.B.
(Stats. Can. Cat. 26-225 & predecessors; 1984-5
from producers)

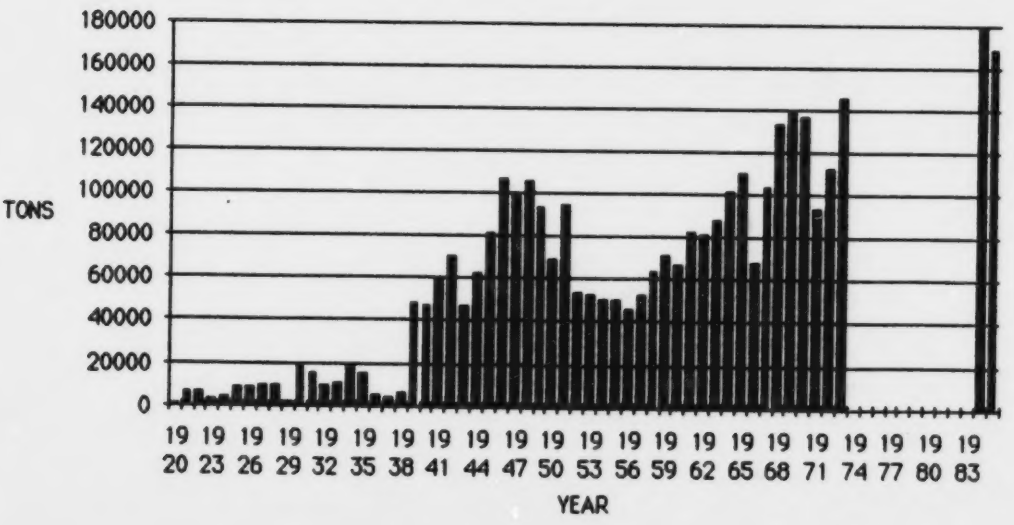
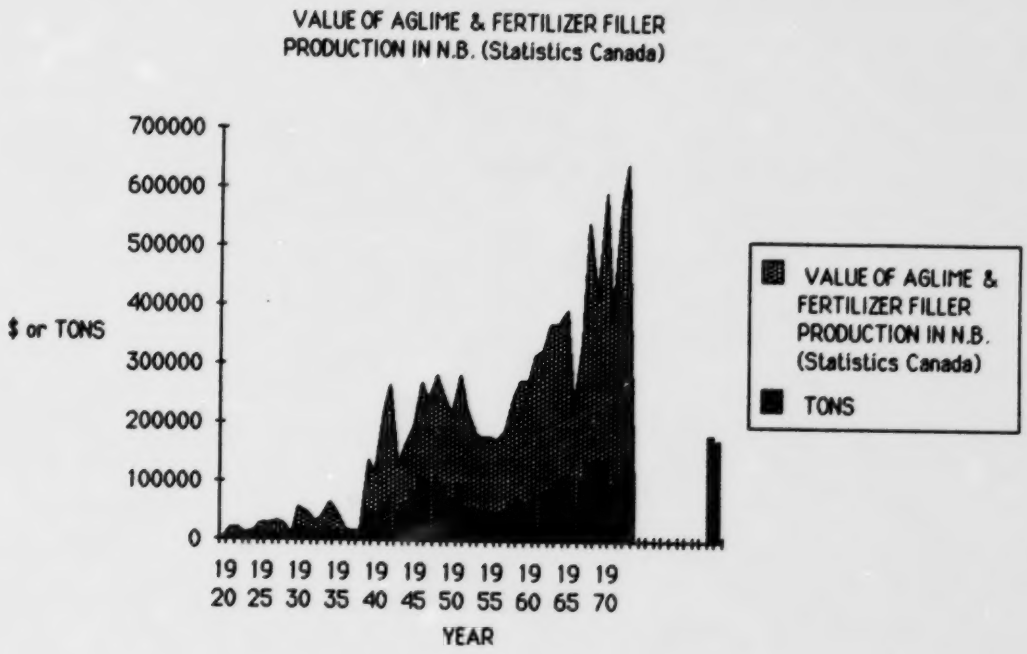
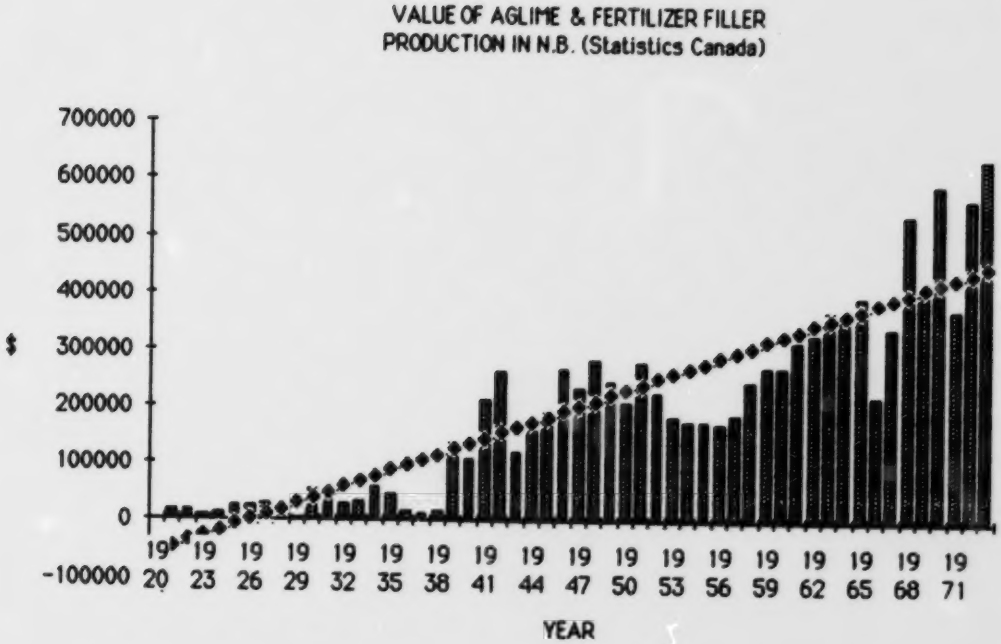


Figure 8


VALUE OF AGLIME & FERTILIZER FILLER
PRODUCTION IN N.B. (Statistics Canada)
700000
600000
500000
400000
300000
200000
100000
0
$ or TONS
19 19 19 19 19 19 19 19 19 19 19
20 25 30 35 40 45 50 55 60 65 70
YEAR
VALUE OF AGLIME & FERTILIZER FILLER PRODUCTION IN N.B. (Statistics Canada)
TONS


VALUE OF AGLIME & FERTILIZER FILLER
PRODUCTION IN N.B. (Statistics Canada)
700000
600000
500000
400000
$ 300000
200000
100000
0
-100000
19 19 19 19 19 19 19 19 19 19 19 19 19 19 19 19 19 19
20 23 26 29 32 35 38 41 44 47 50 53 56 59 62 65 68 71
YEAR

Agricultural limestone must meet the following standards in New Brunswick in order to be eligible for transportation assistance.

a) neutralizing value of 85% or above;

b) fineness - all particles must pass through a 10-mesh screen and 50% through a 100-mesh screen.

Typical analyses of New Brunswick producers are included in Appendix II.

The Nova Scotia assistance policy specifications differ in that at least 60% must pass through a 100-mesh sieve and "dolomitic limestone (calcium plus magnesium carbonate) must have a minimum calcium carbonate equivalent of 90 percent."

Whether dolomitic, magnesium or calcitic limestone is added to soil depends on the deficiency of soil in magnesium relative to calcium. Personal attitude of farmers also is a determining factor. Apparently average calcium content of unlimed farm land in many parts of the Atlantic Region is 400-600 ppm and average magnesium content is 75-120 ppm. If the soil analysis shows a magnesium content of less than 100 ppm, then dolomite or magnesium limestone containing 3.0% magnesium or more is recommended. If the magnesium content is above 100 ppm, then the type generally is not specified. Less than 1000 ppm calcium in soils is considered low. In addition, soil specialists advise farmers to maintain the soil ratio between calcium and magnesium in the 4:1 to 10:1 range. This is because calcium, magnesium (and potassium) are competitive in plant uptake. An unduely large amount of one of these elements relative to the others thus can limit plant uptake of the others. Figure 9 is a typical soil analysis report of the New Brunswick Department of Agriculture.

Figure 9

SOIL ANALYSIS REPORT
RAPPORT D'ANALYSE DU SOL

PLANT INDUSTRY BRANCH
N.B. DEPARTMENT OF AGRICULTURE
& RURAL DEVELOPMENT
P.O. BOX 6000, FREDERICTON, N.B. E3B 5HI

DIRECTION DE L'INDUSTRIE VÉGÉTALE
MINISTÈRE DE L'AGRICULTURE ET DE
L'AMÉNAGEMENT RURAL DU N.-B.
C.P. 6000, FREDERICTON, N.-B. E3B 5H1

DALLAS W. DAVIS (1)
407 DUFFERIN ST.
FREDERICTON
E3B 3A8

YORK

FARMER I.D.
N° D'IDENTITE N/A
TEL 457-1681
DATE 85/11/27

Lab No / No du lab 4138/1-4

SOIL TEST VALUES (kg/ha) AND RATING
VALEURS ET CÔTE DETERMINÉES PAR LES ESSAIS DU SOL (kg/ha)

SUGGESTED APPLICATION
APPLICATION SUGGÉRÉE Kg/Ha

SAMPLE NO.	FIELD NO. / NO DU CHAMP	CROP TO BE GROWN / CULTURE	pH	ORGANIC MATTER / MATIÈRE ORGANIQUE %	PHOSPHATE (P_2O_5) kg/ha	PHOSPHATE (P_2O_5) RTG	POTASH (K_2O) kg/ha	POTASH (K_2O) RTG	CALCIUM (Ca) kg/ha	CALCIUM (Ca) RTG	MAGNESIUM (Mg) kg/ha	MAGNESIUM (Mg) RTG	LIME / CHAUX	NITROGEN / AZOTE (N)	PHOSPHATE (P_2O_5)	POTASH (K_2O)	SUGGESTED FERTILIZER / ENGRAIS SUGGÉRÉ	AMOUNT / QUANTITÉ
1	1	MIXED VEG.	5.5		513+	VH	448+	VH	2549	H	248	H	2500	120	120	120	15-15-15	800
2	2	GRAIN	5.4		48	VL	93	L	1383	M	87	L	6600	60	90	90	10-15-15	600
3	4	GRAIN	5.3		97	L	87	L	984	L	67	L	7200	60	90	90	10-15-15	600
4	6	GRAIN	5.1		73	L	74	L	528	L	45	VL	8400	60	90	90	10-15-15	600

Suggested applications are made for the crops specified; change of crop will require different application rates
1 kg/ha = 0.89 lb/A R = Rating L = Low H = High
1 tonne/ha = 0.45 ton/A VL = Very Low M = Medium VH = Very High

Les applications suggérées sont pour les cultures spécifiées. Tout changement de culture nécessite un taux différent
1 kg/ha = 0.89 lb/A C = Côte B = Bas E = Élevé
1 tonne/ha = 0.45 ton/A TB = Très bas M = Moyen TE = Très élevé

10-1386 (1/83)

RECOMMENDATIONS...

SAMPLE# 2/ 3/ 4/ -
Reduce the rate of fertilizer by 100-150 Kg for each 10 tonnes of manure applied per hectare.
If you are splitting fertilizer application, apply 2/3 of the amount recommended at planting and 1/3 at the second application.

SAMPLE# 2/ 3/ 4/ -
If soil magnesium level is low, dolomitic lime is recommended.

SAMPLE# 1/ -
For broccoli, cabbage, turnips, brussel sprouts, cauliflower, and beets, apply 28 gm(1 oz) of boron per 100 sq. meters.
For peas, beans, beets, and turnips, reduce the rate of nitrogen to be applied by 50%.
If using manure, reduce fertilizer rate by 50%.
If pH is above 5.5, don't apply lime on the potato section of the garden.
For the potato section, increase the fertilizer application rate by 25%.(decrease the rate by 35% with manure.)

NOTE: Sample #1 was taken from a vegetable garden plot which has received annual additions of lime and fertilizer for the past 10 years. Sample #2 was taken from the unfertilized part of the same field. Samples #3 and #4 were taken from fields on the same farm which have not been fertilized for over 20 years.

The farm from which these samples were taken is in Tweedside about 12 kilometers south of Harvey Station, York County. Underlying bedrock is Pennsylvanian sandstone and conglomerate. Till contains a predominance of Mississippian acid volcanics.

Bulk agricultural limestone prices f.o.b. the plant in 1985 ranged from $12.50 per tonne to $14.50 per tonne, depending on the producer and whether the product was dry or damp (conditioned). Havelock and Brookville 1985 price lists for the various agricultural limestone products, packaging alternatives, typical analyses and typical size distribution are presented in Appendix II. The Elmtree f.o.b. price was $12.50 per tonne. It is noted that the bulk product is described as "damp", "conditioned" or "dry". The "damp" or "conditioned" product contains about 5 percent moisture to minimize dustiness and loss of product by wind. It almost has replaced the "dry" product in popularity and now accounts for approximately 90 percent of sales. The principal means of adding the moisture content is as a water spray during milling.

Bagged product accounts for 3-6 percent of "aglime" sales by weight and has been declining in part due to the increasing availability of custom spreading services. Most of the bagged product (80-90 percent) is sold in 40 kilogram paper bags, however 20 kilogram bags are also sold (Brookville) and 10 kilogram bags are filled on a job lot basis for certain retail outlets (Havelock). In addition, one tonne quantities of aglime or other products can be shipped on request in returnable intermediate bulk containers[10]. The problem is that New Brunswick producers are not adequately set up to fill and handle these packs most economically.

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10. Twin Pac Inc., Brantford, Ontario (Jim Barlow, 416-842-1011) is one manufacturer of so-called "intermediate bulk containers" which supplied Havelock, for example, with a 1,700 litre uncoated unit pack 41" x 41" x 62" plus liner at a price of $33 plus freight in 1984. These units have a drawstring at the top and bottom, with a plate across the bottom opening and straps at the top for lifting with a fork lift, etc. Another customer purchases 1,200-litre (41" x 41" x 44") woven polyethelene or polypropylene packs with liners. The liners are supplied in rolls.

    Bonner Packaging (Burlington, Ontario) and Bag Corporation (Winnipeg, Manitoba) also sell intermediate bulk containers).

For shipping to Newfoundland, 20-foot (minimum of 45,000 pounds or 20,412 kilograms) pressurized containers can be and are used for a number of limestone products, including lime and animal feed supplement. Producers in areas with larger and more diversified markets than in the Atlantic Region make greater use of specialty containers. For example, Steetly Industries Ltd. of Hamilton, Ontario ships product in unit packs with up to 6 tonne capacity. These are returnable for up to 6 or more refills and reportedly result in a 20-25 percent saving to the customer relative to purchasing in normal bags.

The 8-16 mesh product of crushing and milling plants (-3.7 + 1.4 mm at Elmtree) is sold as fertilizer filler or "grit". Most producers spray this filler with a calcium chloride-water solution to prevent dustiness. This "coated" product was introduced to the Atlantic Region only several years ago and is much preferred by fertilizer blenders. Filler ideally should have a similar particle size distribution as the fertilizer ingredients. One user noted that 8-14 mesh grit would better match fertilizer component size than the current 8-16 mesh material. Although these sieve numbers describe the range of grit size, it also is given the commercial designation "size 215" which means 2.15 millimeters.

The consumption of fertilizer filler in the Atlantic Provinces has declined over the past few decades because fertilizer sales are lower than they were in 1965 and plant food units per tonne of fertilizer are more than 30 percent higher (Figures 12 and 13). Even over the past decade of marginally increased fertilizer sales, the trend to higher nutrient value per tonne has resulted in declining filler consumption. To illustrate the impact of this trend, it is worth noting that 6-12-12 fertilizer is approximately 50 percent filler (494 or 504 kg/1000 kg with nitrogen as ammonium nitrate or urea, respectively), 10-10-10 is 43 percent filler, 17-17-17 is

32 kg/1000 kg or 3 percent filler with nitrogen as ammonium nitrate and 19-19-19 contains only one percent. Although there may be limited potential for a further decrease in filler usage, this assumption should be made with caution. One blender in the potatoe growing area of Maine has switched to sulphate fertilizer ingredients (Nutrite, Inc., Presque Isle). This blender uses sulphate of ammonia and a sulphate of phosphate and magnesium, but continues to use muriate of potash. With these ingredients, no grit filler at all is required for a 14-14-14 fertilizer and the blending plant annual requirement for grit has declined in the last 5 years from 4-5,000 tonnes to 1-1,500 tonnes.

The 1985 f.o.b. price of fertilizer filler was in the $14-18 per tonne range. In New Brunswick, it is supplied by Brookville, Havelock, Elmtree and Le Carrier Temis of Blue River, Quebec. The latter company supplies 1,000 - 2,000 tonnes of agricultural limestone to northeastern New Brunswick (1,736 tonnes in 1985 to Grand Falls) and about 2,500 tonnes of fertilizer filler[11]. The New Brunswick producers ship 18-20,000 tonnes of filler annually. This represents about 65-75 percent of the estimated 26-30,000 tonne market in which New Brunswick sources could conceivably be competitive. The coated product introduced in the last year or so by the southern New Brunswick limestone producers is liked by the fertilizer blenders and undoubtedly has furthered their market share somewhat. Table VII lists identified fertilizer filler markets.

The trend toward a higher nutrient content per unit of fertilizer, fertilizer sales and the trend in land utilization for farming are all indicators of the future market for agricultural limestone and fertilizer filler. Until the current international surplus of many agricultural commodities is reduced, there will be lower than average

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11. Le Carrier Temis also reported shipping 32,000 tonnes of agricultural limestone to Quebec customers in 1985 and 5,440 tonnes to Maine customers, as well as 2,700 tonnes of fertilizer filler to Maine.

TABLE VII

IDENTIFIED FERTILIZER FILLER MARKETS ACCESSIBLE OR POTENTIALLY ACCESSIBLE BY NEW BRUNSWICK LIMESTONE PRODUCERS

USER & PLANT LOCATION	ANNUAL CONSUMPTION	INCREASING (+) OR DECREASING (-)	SUPPLIER(S)	PRICE ($/TONNE)	SPECIFICATIONS	OTHER INFORMATION
1. CIL Inc. P. O. Box 976 Truro, N. S. B2N 5G7 R. Vair, Manager Phone: (902) 895-2857	± 3,000 t/y sand	Declining slightly as farmers switch to higher nutrient value fertilizer	N.S. Sand & Gravel main supplier based on lowest tender	$25-30, delivered	-Important that not dusty -Important that particle size same as fertilizer ingredients -Deicing grit sometimes used	Supply all N.S. and Nfld customers of C-I-L
2. Chaleur Fertilizers Ltd. Box 640 Petit Rocher, N.B. E0B 2E0 A. Doucet, Manager Phone: (506) 783-4216	± 2,000 t/y limestone	"	Elmtree currently based on lowest tender	In above range	-8-16 mesh, but would be better if 8-14 mesh because all products would match better in size	-Would substitute some other material if available competitively
3. Grand Falls Agromart Ltd. (C-I-L) P. O. Box 1168 Grand Falls, N .B. E0J 1M0 I. Savage, Manager Phone: (506) 473-1941	Av. 1,800 t/y limestone declining over past 3 years	Declining over past 3 years	LeCarrier Temis Blue River, P.Q. 20-30 miles from Cabano Andre Rossignol Vice President (418-893-5583)	$24-26 delivered vs $32-35 delivered from Saint John by truck	-8-16 mesh	-Prefer to have limestone
4. Hartland Agromart Ltd. (C-I-L) P. O. Box 298 Hartland, N. B. E0J 1N0 R. Brennan, Manager Phone: (506) 375-8532	4,000 t/y dolomite	% used in fertilizer declining but tonnage up over 4-5 years.	Brookville	Not available	Same	Same
5. Island Fertilizers Ltd. (5 plant locations) Head Office, Box 334 Charlottetown, P.E.I. C1A 7K7 D. A. Scales, President Phone: (902) 894-5597	5,000 tonnes limestone and dolomite from N.B. + 1,000 tonnes sand from N.S.	Usage declining over past years but probably won't decline much further or as rapidly	Havelock 90% of N.B. material and Brookville 10% N.S. Sand & Gravel	$30 delivered	-Size 2.5 mm -Called "size 215"	

USER & PLANT LOCATION	ANNUAL CONSUMPTION	INCREASING (+) OR DECREASING (-)	SUPPLIER(S)	PRICE ($/TONNE)	SPECIFICATIONS	OTHER INFORMATION
6. Long Fertilizers Ltd. P. O. Box 30 Clair, N.B. E0L 1B0 J. A. Long, Manager Phone: (506) 992-2133	1,500-2,000 t/y limestone	Going down gradually	Brookville 50% and LeCarrier Temis, 50%	$25-30/mt	-Same as others	-Would substitute
7. Malpeque Fertilizers Ltd. P. O. Box 1655 Summerside, P.E.I. C1N 2Y5 D. P. Wood, Manager Phone: (902) 436-4884	+ 1,000 t/y limestone	Static	Brookville 50% and Havelock 50%	$16-17 plus $14-15 for transportation and handling	-As others	-Also sells approximately 200 tpy of bagged "aglime".
8. McCain Fertilizers Ltd. Florenceville, N. B. E0J 1K0 C. Giberson, Manager bought Nutrite Grand Falls Plant this year	-Don't use limestone (?) -Consumption confidential	Not indicated	LeCarrier Temis, Blue River, P.Q., Brookville and Havelock	Not available	-Not given	-Would use limestone, if available competitively.
9. Nutrite Inc. Summerside, P.E.I. C1N 2Y5 L. McCardle, Manager Phone: (902) 436-4234 (now have only one plant in Maritimes - at Summerside)	750 t/yr limestone or dolomite	Not much change expected	Brookville and Havelock	Not Available		
10. Nutrite Inc. Presque Isle, Maine 04769 J. P. LeBlanc, Manager Phone: (207) 768-5791	1,000 - 1,500 t/y limestone	Has declined from 4-5,000 over last 4-5 years but shouldn't change much from now.	N.B. (Brookville, Havelock mainly) and P.Q. (Blue River)	US $17-30	-No preference for limestone, providing dust free.	-Usage declining because have switched to use of sulphate of Ammonia as source of nitrogen. -Also, use sulphate of phosphate and Mg but continue to use muriate of potash. With this combination 14-14-14 requires no grit at all.

USER & PLANT LOCATION	ANNUAL CONSUMPTION	INCREASING (+) OR DECREASING (-)	SUPPLIER(S)	PRICE ($/TONNE)	SPECIFICATIONS	OTHER
11. Westisle Farm Supply Ltd. P. O. Box 309 O'Leary, P.E.I. C0B 1V0 A. W. Sabine, Manager Phone: (909)859-2200	± 1,000 limestone	Down from 1,500 about 4-5 years, and see dropping 10% per year for next because of switches.	Brookville) (½ + ½) Havelock) Havelock was little cheaper		-As others, but coated material preferred because much easier to work with.	
12. Valley Fertilizers Ltd. P. O. Box 370 Kentville, N.S. B4N 3X2 K. Keddy, Manager Phone: (902) 678-6167	1,600 - 1,700 t/y sand	Declining (over past 20 years, units of nutrients in fertilizer have increased 20% and tonnage has gone down).	N.S. Sand & Gravel	$30-35/mt		-Once used N.B. grit but it is currently more expensive than material from Nova Scotia Sand and Gravel.

earnings available to farmers for fertilizer, lime and other purchases. This fact is likely to limit immediate growth of markets and, particularly in potatoe growing areas, could result in lower nutrient additions. In the intermediate to longer term, the trend toward more intensive farming is expected by many agricultural specialists to offset the decline in improved farmland which has persisted since the early part of the twentieth century in New Brunswick, albeit at a reduced pace in the past two decades. Appendix III presents statistics on agricultural limestone and fertilizer consumption in the Atlantic Provinces as compiled by The Atlantic Fertilizer Institute. These data and other data from Statistics Canada Catalogues 96-704 and 903 are depicted in Figures 10, 11, 12, 13 and 14.

Departments of Agriculture in the Atlantic Region have been encouraging farmers to grow more grain locally[12]. If this emphasis is successful and, perhaps, accelerated as a result of farmers being influenced by the economic consequences of too much dependence on one crop (potatoes), "aglime" usage could increase. Much farmland would require an initial application of 5 tonnes per acre to improve the suitability for grain. In addition, acid rain is causing more lime to be required in most areas. A study done at the Federal Research Station in Fredericton a number of years ago apparently concluded that 50-100 pounds of limestone per acre per year is required to offset the effect of acid rain.

The amount of limestone to be added to soils for creating best growing conditions for particular crops is much higher than what is actually being used. In fact, it is unrealistic to expect more than a small percentage of farms in the Atlantic Region to become intensive enough to require the ideal addition of lime. The Prince Edward Island experience is illustrative in that 90-100,000 tonnes of lime addition

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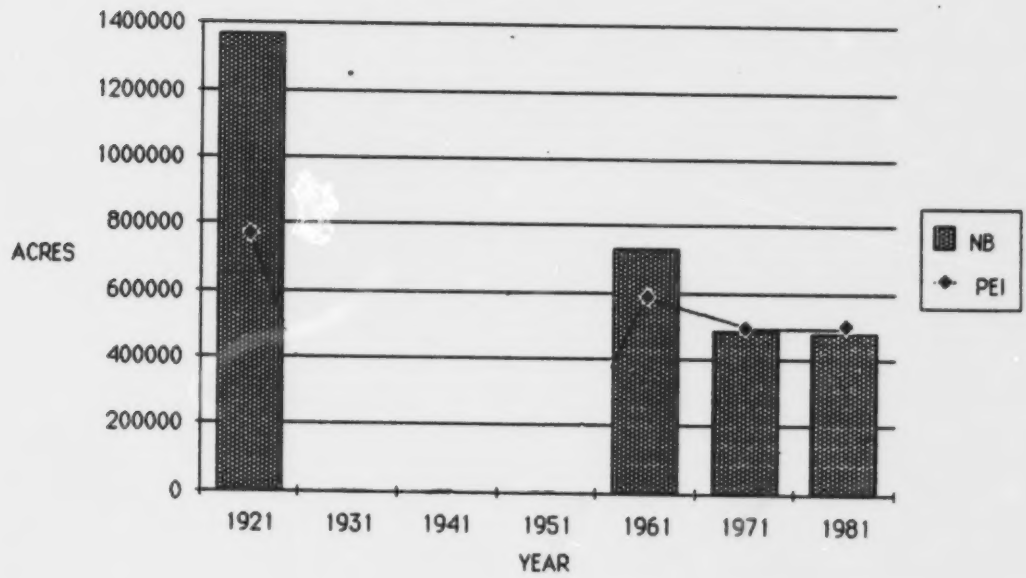
12. Dr. I. Ghanem, N. B. Department of Agriculture

Figure 10

LAND UNDER CROPS AND PASTURE IN NEW BRUNSWICK AND PRINCE EDWARD ISLAND
(Statistics Canada Catalogue 96-704)



PERCENTAGE OF TOTAL LAND AREA IN FARMS
(Statistics Canada Catalogue 96-704)

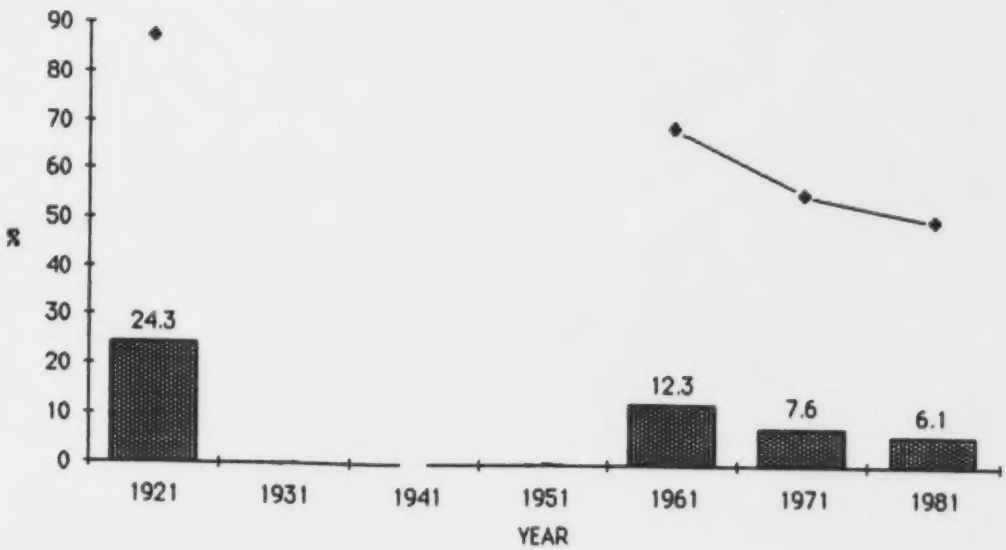


Figure 11

COMPARISON OF NEW BRUNSWICK AND CANADIAN AGLIME & FERTILIZER FILLER PRODUCTION AT 5-YEAR INTERVALS (Statistics Canada Catalogue 26-225)

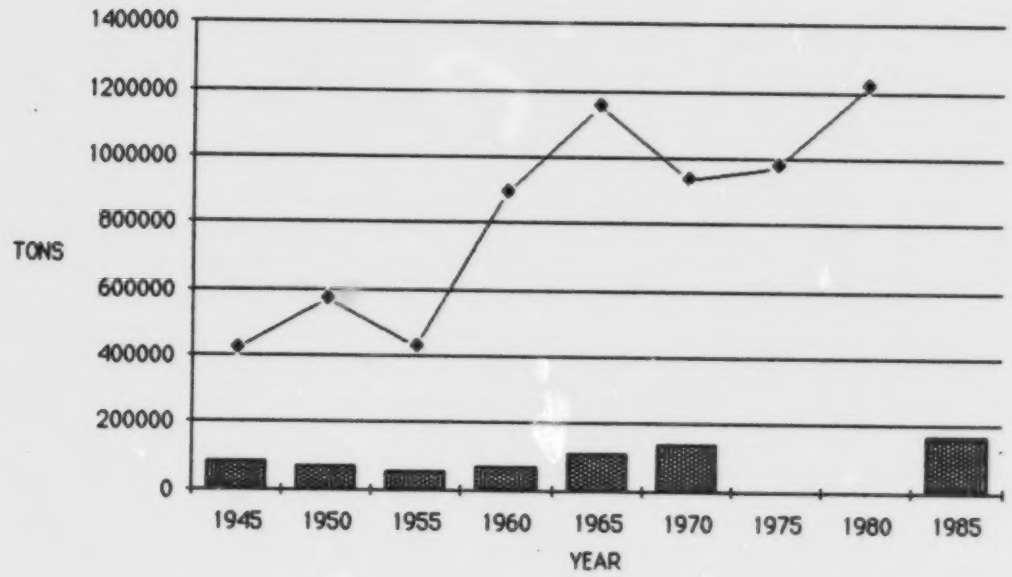
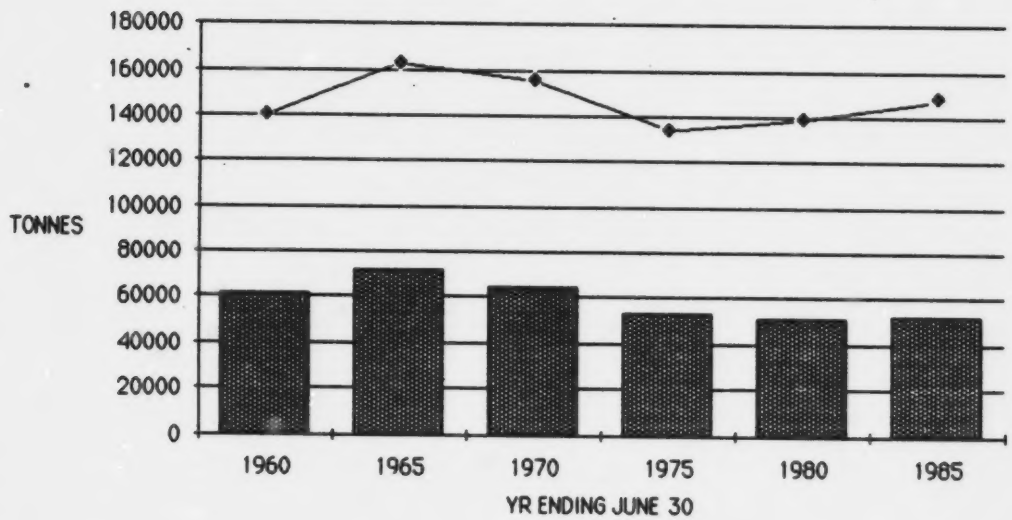


Figure 12

FERTILIZER SALES IN NEW BRUNSWICK & THE ATLANTIC PROVINCES (Source: The Atlantic Fertilizer Institute, Charlottetown, P.E.I.)



PLANT FOOD UNITS PER TONNE OF FERTILIZER SOLD IN THE ATLANTIC PROVINCES (Source: The Atlantic Fertilizer Institute)

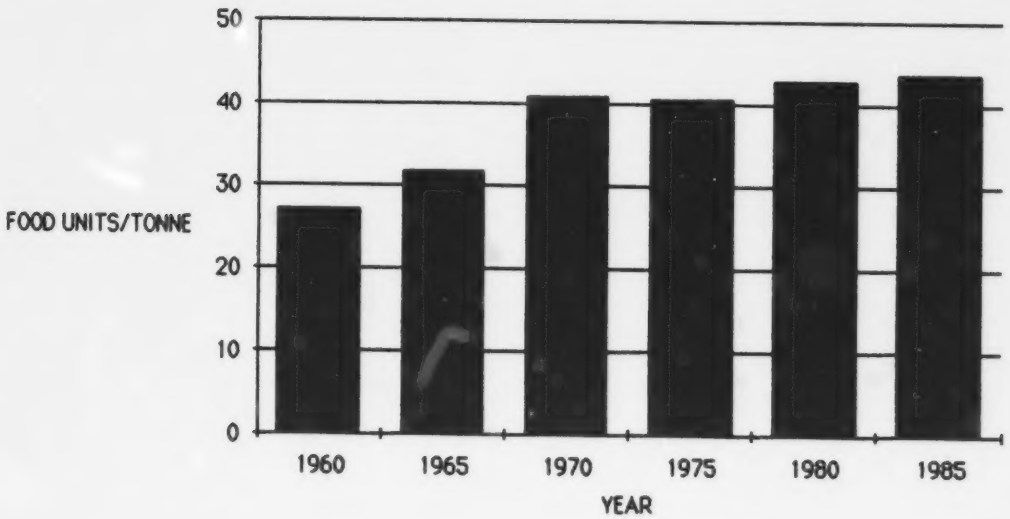
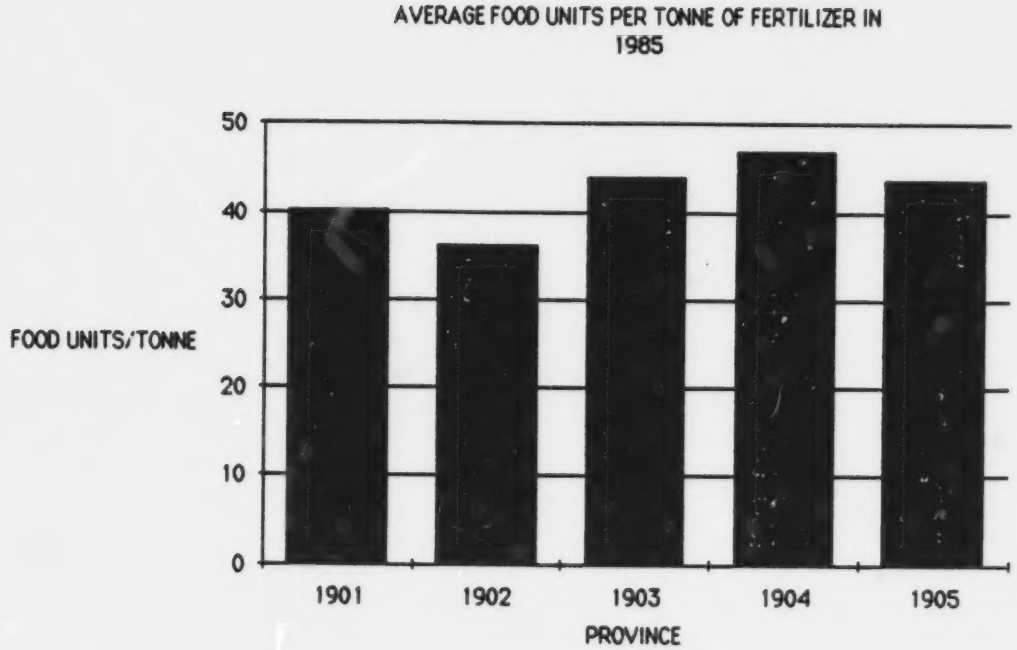


Figure 13

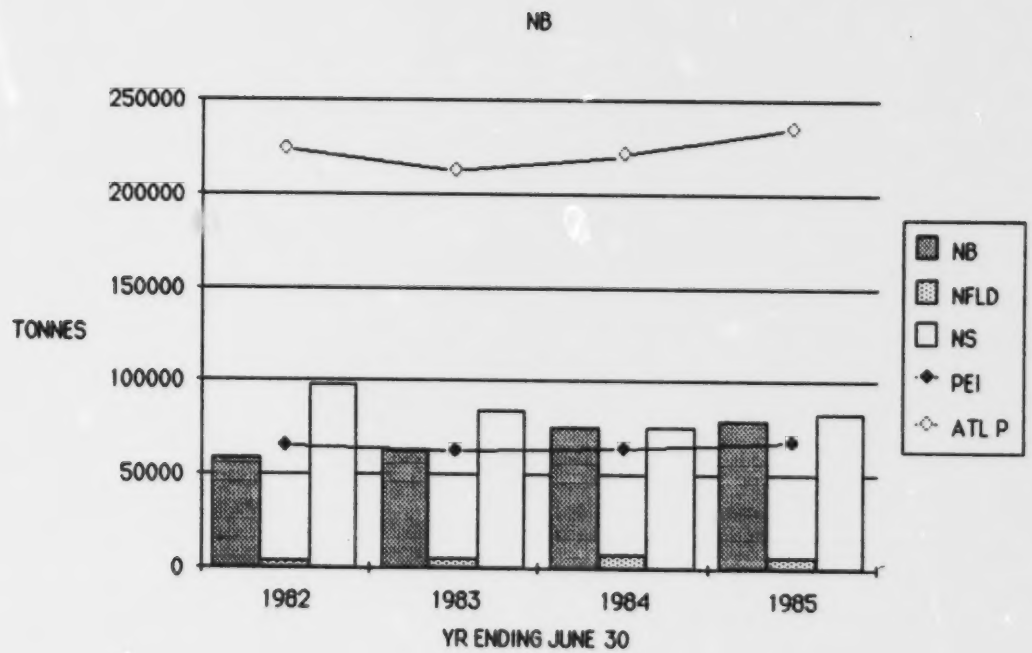


LEGEND

1901--NEW BRUNSWICK	(40.2 UNITS/TONNE)
1902--NEWFOUNDLAND	(36.2 UNITS/TONNE)
1903--NOVA SCOTIA	(43.9 UNITS/TONNE)
1904--PRINCE EDWARD ISLAND	(46.9 UNITS/TONNE)
1905--ATLANTIC PROVINCES	(43.7 UNITS/TONNE)

Figure 14

AGRICULTURAL LIMESTONE SALES IN THE ATLANTIC PROVINCES
(Source: The Atlantic Fertilizer Institute)



annually was set some years ago by Department of Agriculture officials as the minimum amount necessary to sustain agriculture properly. The maximum actually used has been 65-70,000 tonnes and it would be more than optimistic to hope for use of more than 75,000 tonnes[13].

Custom spreading of limestone and the transportation subsidy program both are factors which influence limestone consumption. The latter is dealt with in a separate section of this report. Custom spreading has been the major contributor to a switch to bulk lime purchases over the past few decades and also undoubtedly has contributed to sales growth by lowering the price to the farmer per tonne of "aglime". Encouragement of people to offer custom spreading services could be one means of furthering the growth of sales.

In the Saint John River Valley above Woodstock, there are a number of custom "aglime" spreaders, including Upper Kent Lime Ltd. in New Brunswick and the two producers in the adjacent part of Maine. Jensen Brothers of New Denmark do spreading throughout the area between Woodstock and St. Quentin. Rene Gagnon of Grand Falls and Harold Culberson of Woodstock are the two other prominent custom spreaders in the area. A Jensen Brothers official indicated that their 1986 price for delivery and spreading in the Grand Falls-Drummond area is $26.75 per tonne for Havelock material and $29.00 per tonne for Brookville material, after deducting the government transportation assistance. The difference, in part, is due to the fact that Brookville increased its prices by 5 percent in 1986 to $15.10 per tonne for dry bulk aglime and $14.30 for conditioned material whereas Havelock did not increase their prices. Harold Culberson offers various options to customers, including the rental of spreaders at the rate of $2.00 per tonne. His custom spreading charge varies with location but around Woodstock is approximately $7.00 per tonne.

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13. Richard Vino, P.E.I. Department of Agriculture

Lane Construction Corporation of Presque Isle sells "aglime" at US $8.65 per ton f.o.b. their plant (Can $13.25/tonne). They provide a delivery and spreading service at the rate of US $8.00 per ton for application of one ton per acre, US $6.00 per ton for application of 1.5 tons per acre and US $4.00 for application of 2 tons per acre. Stanley Giles sells marl only on a custom spread basis.

Forest agricultural practice has not included the addition of lime to date in Canada except on an experimental basis. The general conclusion of forestry officials of the region is that acidification of soils may be causing some decline in productivity (Figure 15) but liming of forest soils is "a long way off" for economic and physical reasons. In the long run it will be more physically practical to capture the sulphur dioxide and other acid-forming pollutants at their source.

Fish Farming and Sports Fishery

Fresh water fish farming and the sports fishery require the addition of lime in localities where the bedrock and soil do not have enough buffering capability to offset the effect of acid rain. In New Brunswick only nominal amounts of lime have been used to date to increase the pH (i.e., to lower the acidity) of lakes and fishing ponds. Appendix IV lists the natural lakes which have been limed and the results. Hydrated lime was added in the earlier years of testing (mid-1970's), however it has subsequently been determined that agricultural calcitic limestone is not only much cheaper but increases the pH very quickly. Several abandoned strip mine ponds at Minto have been stocked with trout for winter recreational fishing. About one tonne of agricultural calcitic limestone per year is all that is required to maintain an adequate pH (W. Hooper, D.N.R.E., personal communication). This is equivalent to application of 40-80 pounds per acre. Lime was first added to the Minto ponds in 1969.

Only one privately-owned New Brunswick lake is being limed to maintain angling, that is Disappointment (Mistake) Lake in Charlotte County. In this and other areas of the province underlain by granite rocks, acidic precipitation and swamp run-off may not be naturally buffered.

Total annual consumption of agricultural calcitic lime for enhancing the fishing potential of New Brunswick bodies of water is not likely to exceed 10 tonnes for some years and will probably average 5-7 tonnes over the next decade.

In Nova Scotia, the south uplands area is underlain by granitic rocks and acidity of bodies of water appears to have taken a greater toll with respect to the sports fishery than in the various smaller areas of New Brunswick underlain by granitic rocks. Dr. Walton Watt of the Federal Department of Fisheries and Oceans has been testing various alternatives for lime addition and suggests that 200-500 tonnes of agricultural lime will be required each year. It must contain less than one percent MgO and ideally should have a mean particle size of 35 micrometers. It would be advantageous for the material to be slightly finer than normal agricultural lime, however this is not a definite requirement. Dr. Watt (902-426-3606) does not foresee a need for more than 1,000 tonnes per year to restore and maintain the sports fishery where desired and justifiable in Nova Scotia. The material from Mosher's quarry at Musquodoboit is adequate.

Figure 15

The Daily Gleaner, Tuesday, October 22, 1985 11

Merrithew: Forests In Danger

TORONTO — Gerald Merrithew, Minister of State (Forestry) released a report which warns Canadians there is a substantial risk to Canadian forests from present and future levels of air pollution. He also endorsed Canadian and international initiatives aimed at reducing emissions of long-range air pollution.

Mr. Merrithew made his comments in light of an opinion survey of 39 leading North American scientists conducted by the Canadian Forestry Service. The minister released the report entitled "The Potential Impact of the Long-Range Transport of Air Pollutants on Canadian Forests" at the Sierra Club Woodstock Conference, in Toronto.

"The survey warns us that aerial pollution represents a threat to the economic health of our largest industry. The forest sector represents over $28 billion in commercial activity per annum, so even a minor effect will have a grave impact on the Canadian economy," he said.

The opinion survey of scientific experts on the potential impact of acid rain and other long-range air pollutants was conducted between September 1984 and February 1985. Although the scientists are divided on many subjects and offered a range of opinions, the survey found the following:

—significant forest productivity declines may be already underway in both the Atlantic and Quebec/Ontario regions of the country.

—if pollution levels are allowed to increase or even if they are maintained at present levels into the future, substantial forest productivity decline is expected throughout eastern Canada within the next 10 years. Also, some forest productivity decline is expected throughout western Canada within this time period.

—in contrast, if pollution levels are reduced by 50 per cent over the next decade, no decline in forest productivity is expected anywhere in the country.

Mr. Merrithew noted "there is a very real danger in ignoring this information. There is considerable scientific research underway which will help to clarify the issue. However, waiting for completion of the scientific studies before implementing some pollution controls may result in serious irreversible damage to our forests."

Federal Environment Minister Tom McMillan said the position taken by Mr. Merrithew and the Canadian Forestry Service confirms the decision taken earlier this year by the federal and provincial governments to reduce emissions which cause acid rain. "Acid rain is threatening our forests, one of Canada's major economic resources."

Animal Feed Supplement

Most animal feeds require a calcium additive in the form of calcium carbonate as a nutritional supplement for the animal. This is particularly true for poultry which require the proper amount of calcium to contribute to a sound egg shell. Poultry also require grit, not necessarily limestone grit, for their gizzard to grind food intake. Although the calcium carbonate purity apparently is not important, magnesium limestone and dolomite are not used. Perhaps this is because magnesium is not required in large amounts or because it could act as a laxative.

The Havelock animal feed supplements are sold under the trade names "Sta-Strong", "Calcarb", "Shell Mix" and "Calcium Granules". Smith Brokerage Limited[14] is the wholesale agent for these various feed mill products in the Atlantic Region. Co-op Atlantic, nevertheless, is one company which buys directly from Havelock.

Co-op Atlantic has the following ground limestone specifications for use as an animal feed ingredient[15]:

Calcium	-	38% minimum
Magnesium	-	2% maximum
$CaCO_3$	-	95% minimum
Lead	-	10 ppm maximum
Arsenic	-	10 ppm maximum
Mercury	-	2 ppm maximum

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14. 541 Rothesay Avenue, P. O. Box 1166
Saint John, N. B. E2L 4G5
Telephone: 506#633-7575

15. Mary Hicks, Co-op Atlantic
Moncton, N. B.
Telephone: 506-858-6303

Size	-	granulation from fine powder to free-flowing granules
Colour	-	off-white to grey-brown
Not hydroscopic		

The yearly requirement of Co-op Atlantic is about 1,600 tonnes in bulk and 250 tonnes in 40 kilogram bags. Average delivered price is about $40 per tonne (to Moncton).

Havelock's "Sta-Strong" product to meet the above specifications is made from high calcium limestone by the same screening as for "aglime", that is to yield 100 percent minus 16 mesh or 16-0 mesh as it is sometimes designated. "Aglime", however, does not require high calcium stone. Canada Packers describe their high calcium animal feed supplement produced by Havelock as "Calcarb".

Smith Brokerage Limited sells two Havelock products to Canada Packers and poultry farms - "Shell Mix" and "Calcium Granules". The latter product accounts for 30-40% of the some 10,000 tonnes of calcium carbonate food supplement which they handle each year. "Shell Mix" accounts for about 20% and has been losing market share to "Calcium Granules". The remaining 40-50% is "Sta-Strong".

"Shell Mix" is in the 6-16 mesh size range and is produced by screening high calcium limestone. It should be noted that this is a slight variation from the size range used for fertilizer filler. Screens are periodically changed (see flow chart for Havelock in chapter describing operations).

"Calcium Granules" is produced by subjecting "Sta-Strong" to an air-separator and collecting the 16-100 mesh sizes.

Co-op Atlantic has no specifications for poultry supplement except that it should be chemically the same as the ground limestone for animal feed supplement. They purchase from Havelock about 350 tonnes of "Shell Mix" per year in 40 kilogram bags plus 400 tonnes by bulk in 15 tonne loads. Average delivered cost is approximately $45 per tonne. In addition, they purchase 2-24 tonne carloads per year of bagged siliceous chick and hen grit from Bolander's of Haliburton, Ontario. The delivered price is approximately $155 per tonne (Moncton).

After deducting transportation cost from the above delivered prices it would appear that Havelock's prices for animal food supplements are similar to those of other producers (f.o.b. prices) outside the province, such as Pfizer (Adams, Massachusetts) and Jolichaux (Joliette, Quebec). However, since these companies each have their own somewhat unique specifications, it is possible to make only general comparisons.

The Atlantic Provinces market for calcium carbonate animal food supplement is supplied almost entirely by Havelock Lime Works. The annual market is in the order of 4,000 tonnes for "Shell Mix", 4-5,000 tonnes for "Calcium Granules" and 5-6,000 tonnes for "Sta-Strong."

Peat and Peat-Soil Mixes

For at least 10 years peat producers in New Brunswick have been preparing soil mixes for horticultural use. Heveco of Tabusintac, Northumberland County has been using limestone in peat-soil mixtures for more than 10 years[16], however it was not until 1980, when ASB Greenworld Ltd. began operation at Point Sapin in Kent County, that production of soil mixes became a significant activity in New Brunswick. The limestone is added to bring the pH of the mix to the desired level and, of lesser importance, to provide calcium and magnesium nutrients. It should be noted that peat

16. Mr. Mecking, 506-779-9277

from different bogs or locations within bogs requires different additions of limestone to achieve the desired pH. Limestone consumption by the five user companies listed in Table VIII was 800 to 900 tonnes in 1985 and is expected to be 1,200 to 1,300 tonnes in 1986:

TABLE VIII: LIMESTONE CONSUMPTION AND SPECIFICATIONS FOR PEAT-SOIL MIXES

Company	Usage, Suppliers and Specifications
1) ASB Greenworld Ltd. Pointe Sapin Kent County, NB E0A 2A0 Contact: Andreas Avenriep 506-876-3937	- 550 tonnes in 1985; up to 700 tonnes in 1986 and typical immediate future years. - Purcase in trailer loads of 40 kg bags. - Now purchase from Brookville because their product is closest to material of former supplier, Lee Lime of Adams, Mass. Have also tried Havelock limestone in past but magnesium content is not high enough. - Ideal specifications, i.e., Lee Lime product: minimum MgO - 20%; Mg - 12% minimum Ca - 30%; Ca - 21.4% 98% passing through #20 US Std. Sieve 89% " " #100 " " " 68% " " #200 " " " 42% " " #325 " " " - Although the Brookville "aglime" is closest to these specifications chemically, it is coarser and 10 kg/cu.m of mix is required vs. 6.6 kg of Lee lime to achieve a pH of 5.5. - Cost of Brookville lime on a delivered basis is approximately $28/tonne less than Lee lime. Cost per unit of peat soil mix is nearly the same, however Brookville material has the advantage of being available on short notice.

Company	Usage, Suppliers and Specifications
2) Fafard Peat Moss Co. Ltd. P. O. Box 70 Shippagan Gloucester County, NB Contact: Laurent Boudreau 506-336-2325	- 59.9 tonnes purchased in 1985, of which 42.8 tonnes used; increased production in 1986 and thereafter forecast to require 232 tonnes. - Supplied by Lee Lime of Adams, Mass. in 40,000 pound truckloads of 80 lb bags, taking advantage of backhaul opportunities when available. Buying done at head office in Massachusetts. Have considered switching to NB supplier. - 2 qualities of limestone purchased in 1985 in about equal amounts. "Calmag" - 98% passing #20 US Std. Sieve - 75% " #100 " " " - 28.5% Ca;4.5% Mg. "Highmag" - 98% passing #20 US Std. Sieve - 40% " #100 " " " - 21.4% Ca; 12% Mg. - In 1986 and future expect to use only "Calmag". - Prefer fine material for pH adjustment, thus fineness more important than Ca and Mg content or ratio. - Also expect to buy 53.5 tonnes of bagged gypsum from Mass. supplier in 1986 and future years; 6 tonnes of "Premix" containing gypsum and limestone; and 47.6 tonnes of calcium nitrate (from US through Plantco, Bramalea, Ontario).
3) Heveco Ltd. P. O. Box 30 Tabusintac Northumberland County NB, E0C 2A0 Contact: Mr. Mecking 506-779-9277	- Purchase 5 to 10 25-tonne truckloads of "aglime" per year from Havelock to adjust pH of mixes.

Company	Usage, Suppliers and Specifications
4) Lameque Peat Moss Ltd. P. O. Box 570 Lameque Gloucester County, NB E0B 1V0 Contact: Florent Chiasson	- Plans to start using limestone in 1986 for soil mixes and test market, then next year expect to produce mixes on sustained basis. - In 1986 will require about ½ tonne of limestone and thereafter 2-3 tonnes. - Supplier: Elmtree
5) Jiffy Products (NB) Ltd. Shippagan, Gloucester County, NB 506-336-2284	- Use 100 tonnes limestone per year in "Jiffy 7" pellets to control pH. - Supplied by Lee Lime of Adams, Mass. until 1985 when switched to Brookville. Apparently, Lee Lime had ceased to produce material with the desired 4.5% Mg content and alternative material from Lee has too much Mg (12%). - Jiffy preferred specifications: 98% passing #20 US Std. Sieve 89% " #100 " " " 68% " #200 " " " 4.5% Mg max.; 28.5 Ca and very close to 0% moisture (water). - Brookville supplies an acceptable 10% Mg product ("Superfine") with very low moisture content and the following size gradation: 100% passing #10 sieve 0.1% retained on #20 sieve 16.6% " " #50 " 10.7% " " #100 " , and 50% passing #200 " - Previously obtained Lee Lime material at about same delivered price as it now costs from Brookville (usually on a backhaul).

Fillers, Extenders, Coatings and Whiting Substitute

The market for calcium carbonate as a filler, extender, coating and/or whiting substitute is diverse and specialized. There are a number of consumers in the Atlantic Region, however none has been supplied with consistently satisfactory material by local limestone producers. This illustrates the specialty nature of the market.

Crossley Karastan Carpet Mills Ltd.[17] of Truro, Nova Scotia at approximately 1,600 tonnes per annum (3.5 million pounds) is the largest identified market for filler (in foam carpet backing). For a few years the company bought about 1,000 tonnes per year of - 325 mesh limestone from Havelock Lime Works at a delivered price of 2¢ per pound ($44/tonne in 1983-84). At that time they also bought about 150 tonnes per year of "Pulpro #1" (8 microns) from Industrial Fillers Ltd. This was delivered in bulk truckloads at 6¢ per pound from the quarry and plant at St. Armand near Bedford, PQ. Since then, purchases have been switched entirely to Industrial Fillers and only "Pulpro 5" is used. Properties of "Pulpro 5" are:[18]

Typical Physical Properties	
Dry Brightness (Green Filter	90
Refraction Index	1.60
Specific Gravity	2.71
Oil Absorption (Rub-out Method ASTM D281-31)	12
pH Saturated Solution	10
Moisture Loss at 110°C (%)	0.5
Apparent Bulk Density	
Loose Bulk Density	0.5 g/cc or 32 lbs/ft^3
Packed Bulk Density	1.2 g/cc or 75 lbs/ft^3

Typical Particle Size	
% Retained on 325	trace
Top Cut	20 microns
Mean Particle Size	5 microns

Typical Chemical Analysis	
$CaCO_3$ (%)	96
$MgCO_3$ (%)	2
Acid Insolubles (%)	4

17. Purchasing agent and chemist, Crossley Karastan Carpet Mills Ltd., Truro, NS.

18. From specifications sheet of Industrial Fillers Ltd., 2020 University Street, Suite 1255, Montreal, Canada H3A 2A5 514-844-3425

Crossley decided not to continue using Havelock material because shipments contained too much soluble calcium. This results in a higher pH of the latex than desired, unstable viscosity and too little foaming to produce the best quality carpet backing. In addition, CP Rail will now deliver by hopper car from Montreal at a rate which makes the delivered cost of 2.5¢ per pound ($55/tonne) competitive with the delivered cost from Havelock by truck.

Although the large Michelin rubber industry in Nova Scotia would appear to be a logical market for finely ground limestone, officials of the company say that this is not the case. Perhaps their rubber is premixed elsewhere as is done for the retread companies, such as Atlantic Rubber Ltd. of Minto.

Since New Brunswick has a large pulp and paper industry, it is worth examining whether this is or could be a future market for fillers and coatings, and, more particularly, whether there is potential for calcium carbonate to displace materials such as kaolin and other clays. In this case, it would be precipitated calcium carbonate (PCC) of basically two grades that would need to be produced as limestone from New Brunswick's known and developed limestone deposits would neither be white enough or competitively amenable to sufficiently fine grinding. The product grade for filler would need to have an average particle size of 1.5 - 2.0 microns and for coatings an average particle size of 0.6 - 0.8 microns. Other requirements are also stringent, that is, colour of 92 GE brightness, proper particle size distribution, and availability as a high solids slurry without agglomeration.[19]

The Atlantic Provinces pulp and paper industry until now has not been a major user of fillers because these are not required for its primary output, that is, newsprint, kraft paper, paperboard and

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19. North, R. B., "Calcium Carbonate - A Changing Market", Industrial Minerals, Pigments and Extenders Supplement, May 1985, pp. 43-50.

wood pulp. However, Miramichi Pulp and Paper Ltd.[20], a subsidiary of Repap Enterprises Inc. of Montreal, completed construction of a plant at Newcastle in mid-1986 for production of 200,000 tonnes a year of lightweight coated paper stock. A kaolin slurry is being brought in by rail from Georgia and a ship unloading facility is being built to take advantage of backhaul opportunities on pulp ships. The anticipated annual consumption of clay slurry containing 70% solids will be 90,000 tonnes. It was decided to use the same process in this mill as in another coated paper mill owned by Repap at Kimberly, Wisconsin (315,000 tpy of similar coated stock). Although it is possible for mills to convert from clay to calcium carbonate in whole or in part, Miramichi Pulp and Paper has no plans to do so. Perhaps, in time, they would consider such a conversion if a sufficient cost saving could be demonstrated.

The one other producer of coated paperboard (Edmundston, N. B.), coated paper and fine paper (Madawaska, Maine) which is partly in the Atlantic Provinces is Fraser Inc. Company officials would not disclose qualities, specifications or suppliers of calcium carbonate, however their laboratory people indicated that experiments are being done on the use of calcium carbonate instead of clay. Any partial or complete switch will be much dependent on the economics. Currently, the only usage appears to be about 110 tonnes of PCC per year for the last coat on paper as an extender in conjunction with titanium dioxide to provide optical brightness. Based on industry averages, the potential market for PCC at the Fraser operations could be as much as 18% of the annual finished paper output of 350-365,000 tonnes per year. However, a more realistic assumption is that PCC would comprise 50% or less of the filler. This implies a PCC market potential of some 30,000 tonnes per annum.

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20. John MacDougal, Technical Manager, Miramichi Pulp and Paper Ltd., personal communication.

The pulp and paper industry of Maine produces a much greater range of products, including more of a higher unit value and specialty nature, than is the case in the Atlantic Provinces (Table IX). The paper products capacity is 10,233 tonnes per day or approximately 3,580,000 tonnes per year. Much of this is specialty and fine papers rather than newsprint or equivalent. A survey of the different products and their filler requirements is beyond the scope of this study, however it is undoubtedly very safe to assume that at least 25% or approximately 900,000 tonnes of annual production could accommodate 18% filler. This implies a PCC market potential which almost certainly is much in excess of 162,000 tonnes, if all the filler were to be PCC. This includes the Fraser operation discussed in the previous paragraph, but not the Repap Miramichi mill. Over 100,000 tons of lime would be required annually to manufacture PCC for the prospective market which could be competitively served from New Brunswick.

Precipitated calcium carbonate (PCC) and ground calcium carbonate (GCC) are gaining inroads as fillers in the papermaking industry of North America. This has been at the expense of kaolin and other clays. In 1978, calcium carbonate papermaking usage in the United States was estimated at 20,000 tons.[21] By 1983, estimated consumption had grown to 162,000 and by 1988-89 and is variously forecast to be 235-490,000 tons.[21, 22] In 1983, PCC accounted for an estimated 85,000 tons and GCC for 77,000 tons.[21]

Traditional North American papermaking with a clay filler is done in an acidic environment. Calcium carbonate can substitute, providing the environment is neutral or alkaline. Apparently, paper mills in North America adopted the use of clay and an acid environment because clay was available and sufficiently fine calcium carbonate was not

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21. Duncan, Peter A., "Filler Consumption in the U.S. Domestic Paper Industry", Industrial Minerals, Pigments and Extenders Supplement, May 1985, pp. 77-81.

22. Chapnerker, V. D., "Precipitated Calcium Carbonate Technology for the Paper Industry", a paper presented at the National Lime Association Convention, Pebble Beach, CA, April 1985, 8p.

TABLE IX - PAPER PRODUCTION CAPACITY IN MAINE

(Source: Paper Industry Information Office,
133 State Street, Augusta, Me 04330
Telephone 207-622-3166)

Company	Plant Location	Paper and Related Finished Products	Daily Paper Capacity (tons)	Daily Sulphite, Kraft, Thermo-mechanical and Groundwood Pulp Capacity (tons)
Boise Cascade	Rumford	Commercial printing, periodical publishing, book, converting papers	1,450	1,140
Eastern Fine Paper	Brewer	Bond, book, business, duplicating, index, silicone, gum coated specialty papers	170	-
Fraser Paper	Madawaska	Bonds, books, coated fine, directories, publication, catalogues, specialty papers	1,200	
Georgia Pacific	Woodland	Specialty and fine papers	300	650
Great Northern	Millinocket & East Millinocket	Uncoated grades - catalogue, directory, business forms, newspaper publishing and other bleached and unbleached printing paper. Coated grades - magazine, workbook, catalogue and commercial printing	2,400	2,212
International Paper	Jay (near Rumford)	Bond papers, tablet, business forms, carbonizing tissue, machine coated publication, envelope papers	1,400	-
James River	Old Town	Tissue products	190	600
James River-Otis	Jay	Conductive copy base, carbonizing bond, specialty coating base, carbonless base, release base paper	135	-

Company	Plant Location	Paper and Related Finished Products	Daily Paper Capacity (tons)	Daily Sulphite, Kraft, Thermo-mechanical and Groundwood Pulp Capacity (tons)
Keys Fibre	Shawmut Waterville	Formed fibre plates, dishes, cakes circles, trays, egg cartons, filler flats, fruit packs, interior packaging	-	120 225
Lincoln Pulp & Paper	Lincoln	Bond, duplicator, offset, xerographic copy paper, wet-strength tissue	260	350
Madison Paper	Madison	Uncoated groundwood super calendered printing papers	600	285
Pejepscot Paper	Topsham	Specialty papers, school construction, groundwood offset printing, ss. groundwood printing, converting, commercial printing papers, business forms	170	160
Scott Paper	Winslow (Packaged Products Div.)	Specialty, tabulating card, wax base paper, towels, sanitary tissue papers	450	
	Skowhegan & Westbrook (S.D.Warren Div.)	Book, coated cover, commercial printing, converting graphic, specialty papers	1,200	1,200
St. Regis	Bucksport	Coated printing papers for magazine and catalogue publishers	1,125	325
Statler Tissue	Augusta	Household tissues, towels napkins	150	-
US Gypsum	Lisbon Falls	Insulation board	-	130
Yorktowne Paper	Gardiner	Boxboard, laminated, tube stock, wrapper, roll headers	80	-
		TOTAL	11,280	7,397
		(tonnes)	(10,233)	(6,711)

competitively available. Many paper mills did tests in the early 1970's on using PCC and GCC. A number of plants using GCC were built, but it soon became accepted that GCC is not as effective as PCC and a shortage of PCC production capacity helped limit growth of alkaline papermaking.

Fibre substitution and high strength are achieved by using GCC while high opacity and low abrasion are the advantages of using PCC. Overall, calcium carbonate offers brightness, strength and recyclability advantages over clay as well as the prospect of additional advantages to the papermaker, such as reduced energy requirements, cleaner machine operation, lower effluent costs, reduced corrosion and a need for less water. Of considerable economic importance is the opportunity to lower cost by increasing filler from the 10 % range for clay acid papermaking systems to 20 % for calcium carbonate alkaline systems. "This replacement of filler at US $150/ton for fiber at US $300-400/ton is very significant."[22] In addition, good quality paper can be made from less expensive hardwood pulps which would have made low quality paper with clay acid media systems.

Although PCC and GCC both are fillers, whiteners and extenders, PCC manufacture first requires calcination and hydration. Thus, the PCC market is of considerable relevance to the lime industry. Improvement of the quality of lime in order to meet PCC market specifications is accomplished primarily by size separations during the slaking step or the carbonation steps where carbon dioxide is reacted with calcium hydroxide to produce PCC. In these steps, impurities are removed and the desired particle size, shape and distribution are achieved. The GCC process is economical if the desired particle size is larger than 2 microns and there is no stringent demand on brightness.

Until recently, limestone producers have done relatively little market development work in the sense of identifying prospective growth

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22. Chapnerket, V. D., "Precipitated Calcium Carbonate Technology for the Paper Industry", a paper presented at the National Lime Association Convention, Pebble Beach, CA, April 1985, 8p.

markets, such as substitution of calcium carbonate for clay in the paper industry, then taking strategic measures to capture and bring about growth of that market. PCC would offer such an opportunity and challenge to the industry. Apparently, the technology required to switch from acid to alkaline systems is relatively simple. One limestone industry official recently expressed the challenge as follows:

> "The added capacity . . . is coming on primarily to service the paper market and will be the ultra fine products, the 2 micron average and the 7/10 micron average particle size. . . . It is a matter of which comes first. You have to have the carbonate capacity or the paper manufacturers are not going to switch over to alkaline sizing. In fact, they have come to us and made that very clear . . . (The products they require) will be primarily slurries."

One means of market development by the lime industry has been to offer to build PCC manufacturing facilities at paper mill sites. This reportedly has much increased the interest in alkaline systems using PCC because the delivered price is competitive with clay and GCC.[22]

Paint manufacturers in the Atlantic Provinces have an annual requirement of about 500 tonnes of calcium carbonate, primarily as an extender of the efficiency of the primary pigment. The principal users are Laurentide Chemicals Atlantic Division Ltd. (Richibucto, NB), Tibbetts Paints Limited (Trenton, NS), Northumberland Chemicals Inc. (Charlottetown, PEI), and The Standard Manufacturing Co. Ltd. (St. John's, NFLD). The following information on these users demonstrates how specifications and pricing varies.

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22. Chapnerker, V. D., "Precipitated Calcium Carbonate Technology for the Paper Industry", a paper presented at the National Lime Association Convention, Pebble Beach, CA, April 1985, 8p.

Laurentide Chemicals Atlantic Division Ltd. uses 40-50,000 pounds per year of calcium carbonate at their Richibucto paint factory.[23] This calcium carbonate under the brand name "Atomite" is purchased in 50 pound bags through St. Lawrence Chemicals from Thompson and Weiman, a distributor in the United States. Specifications are: particle size in the 0.5 - 10 micron range and a mean size of 2.5 microns, refractive index of 1.59, pH of 9.2 - 9.5, density of 2.71, minimum dry brightness of 95 % and $CaCO_3$ content of 98.2 %. Delivered cost is approximately 15¢/pound ($330/tonne).

Tibbetts Paints Limited[24] requires about 660,000 pounds of calcium carbonate annually, primarily as an extender in the manufacture of paint for lines on highways (traffic paint). It is obtained from Steeprock Calcite of Perth, Ontario at a price of $63/tonne f.o.b. Perth. Detailed specifications were not provided, however, it was pointed out that brightness requirements are not necessarily the highest because other ways besides adding inerts have been discovered for creating paint brightness.

Northumberland Chemicals Inc.[25] uses 120,000 pounds per year of calcium carbonate ground to the 2.5 - 5 micron range and with approximately a 96 brightness. The supplier is St. Lawrence Chemicals of Montreal. The cost is 8 - 15 cents per pound ($175 - 330/tonne) depending on the particle size. At lease three sizes are utilized.

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23. Rene Martin, Purchasing Agent
Laurentide Chemicals Atlantic Division Ltd.
P. O. Box 189, Richibucto, Kent County, NB E0A 2M0
(506) 532-4469

24. Mr. Carrigan, Purchasing Agent
Tibbetts Paints Limited
P. O. Box 40, Glass Street, Trenton, Pictou Co., NS B0X 1X0
(902) 752-8301

25. Mr. McKittrick, Purchasing Manager
Northumberland Chemicals Inc.
72 Allen St., P. O. Box 2620, Charlottetown, PEI C1A 8C3
(902) 894-9556

Plastics and fiberglass manufacturers in the Atlantic Provinces are small and their requirements are specialized, thus, they would be of minor consideration in any decision of a local company to produce finely ground or precipitated calcium carbonte. Maritime Fiberglass, for example, uses 4 - 5 bags/year of "Cabosil" which probably has a calcium carbonate base. Polymer International's polyethelene and polypropylene plant at Truro consumes about 144,000 pounds per annum of $CaCO_3$. It apparently is produced in finely powdered form in Vermont then shipped to Belgium for special processing to allow proper coupling between the mineral and the plastic resin. This prepared $CaCO_3$ is in prill form.

Asphalt filler[26] is required to be limestone dust only in the Moncton area where approximately 1,000 tonnes of Havelock material are consumed per year. Apparently, dust from ordinary quarry stone is adequate to inhibit stripping of asphalt from aggregate, except in the case of stone from Gayton, The Gorge Road and Stilesville quarries. Filler should meet ASTM Specifications C207. In practice, 0.5 - 1.5% of the asphalt-aggregate mix is filler, of which 95 % is minus 75 microns.

Pfizer Inc. is one of the major suppliers to the Northeast of dry and slurry precipitated calcium carbonate (PCC) from their facility in Adams, Massachusetts. The products sell under brand names "Abafil" (slurry with 54 % solids) at US $177.00/dry ton f.o.b., and "Albaglos" (several technical grades, dry) at US $217.00/ton f.o.b. Adams. In addition, Pfizer sells a range of finely ground and coated products (GCC). Specifications are numerous and comprehensive so all except "Albafil" (Table X) are provided under separate cover.

In Vermont, Quebec and Eastern Ontario, there are a number of producers of white finely ground calcium carbonate. These are:

1) Steep Rock Calcite
   P. O. Box 245, Perth, Ontario K7H 3E4
   Telephone: 613-267-5367 or 1-800-267-7980

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26. Tom Gorman and Bob Mersereau, NB Department of Transportation.

Pfizer
MINERALS, PIGMENTS
& METALS DIVISION
235 EAST 42nd STREET, NEW YORK, N.Y. 10017

TABLE X

ALBAFIL® SLURRY

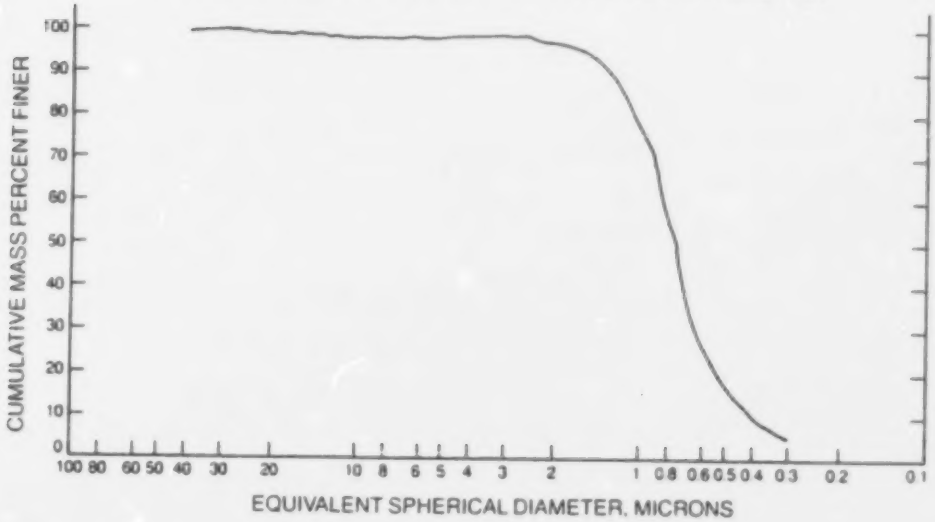
Albafil precipitated calcium carbonate slurry is a high brightness, high purity, controlled particle size filler/extender especially designed for alkaline wet end applications. To ensure product uniformity, Albafil is chemically precipitated with control over each step of the manufacturing process. Both fine particle size and narrow particle size distribution result in an optically efficient pigment that provides increased brightness and opacity to the filled paper.

Chemical Composition (Typical)	
$CaCO_3$	98.3%
$MgCO_3$	1.0%
SiO_2	0.15%
Al_2O_3	0.15%
Fe_2O_3	0.07%

Particle Size Distribution
90% <1.5μ
50% <0.8μ
10% <0.4μ

Physical Properties (Typical)	
Slurry Solids	54 ± 1%
Weight/Gallon	12.6 lbs.
Dry Solids/Gallon	6.8 lbs.
Brookfield Viscosity (20 rpm)	2000 cps
325 Mesh Residue	0.02% maximum
Dry Brightness	97 minimum
Surface Area	7.5 m^2/gram
Einlehner Abrasion	<7 mg
Crystal Habit	Rhombohedron (Calcite)

ALBAFIL SLURRY TYPICAL PARTICLE SIZE DISTRIBUTION



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This paper contains Albafil slurry

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PFIZER TECHNICAL DATA

ALBAFIL® SLURRY

Products are fillers, extenders, agricultural limestone and a wide range of coarser sizes. Total annual production is approximately 200,000 tonnes. Two grades of ultra fine calcium carbonate primarily for the paper industry, are being added to the product line in October 1986 - a minus 4 micron grade and a minus 2 micron grade.

2) Industrial Fillers Ltd.
St. Armand (near Bedford in Eastern Townships)

Primarily a producer of ground calcium carbonate fillers. Company purchased by Bluss Staufer Industries of Austria in 1983-84. Prior to that time, it claimed to have 80 % of the Quebec filler market with output of 75-85,000 tonnes/year.

3) Omya Group (owned by Pluss-Staufer AG of Aftringen, Switzerland)
Vermont

The largest European producer of ground calcium carbonate (46%) and like Bluss Staufer, appparently is positioning itself to take advantage of the North American market potential.

4) White Pigment Corporation
Florence, Vermont

In Canada, production (sales) of "whiting" or finely pulverized limestone increased from approximately 15,040 tons in 1973 to 38,580 tons in 1983 and average value per ton from $19.93 to $50.08 (Table XI).[27]

United States Customs statistics show that about 4,007 tonnes of PCC are imported (1984) through Customs Districts in the Northeast, that is, an area bounded on the south by New York City and on the west by Ogdensburg, New York. Average value was US $300/tonne. Only 0.77

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27. Statistics Canada Catalogue 26-217 and Canadian Minerals Yearbook of the Department of Energy, Mines and Resources.

TABLE XI

CANADIAN PRODUCTION (SALES) OF WHITING (SUBSTITUTE) MANUFACTURED
BY PULVERIZING LIMESTONE OR MARBLE

Year	ALBERTA		QUEBEC		ONTARIO		BRITISH COLUMBIA		MANITOBA		CANADA TOTAL	
	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$	Tons	$
1946	-	-	6,760	67,600	4,095	22,099	266	3,392	-	-	11,121	93,091
1947	-	-	9,162	109,944	7,341	41,704	257	3,581	-	-	16,760	155,229
1948	-	-	9,870	118,440	7,804	48,960	318	4,509	-	-	17,992	171,909
1949	-	-	8,130	97,560	7,290	35,522	237	3,081	-	-	15,657	136,163
1950	-	-	10,487	125,848	6,756	40,832	360	5,780	-	-	17,603	172,460
1951	-	-	12,030	144,360	6,050	41,724	300	4,643	-	-	18,380	190,727
1952	-	-	12,481	149,772	4,746	34,672	300	3,600	-	-	17,527	188,044
1953	-	-	11,767	141,204	4,729	34,487	417	5,421	-	-	16,913	181,112
1954	-	-	11,611	139,335	-	-	3,849	16,722	-	-	15,460	156,057
1955	-	-	11,764	141,169	-	-	4,243	21,562	-	-	16,007	162,731
1956	-	-	12,408	148,890	-	-	5,040	25,230	-	-	17,448	174,120
1957	-	-	13,168	158,014	7,928	45,397	431	5,680	-	-	21,527	209,091
1958	-	-	11,686	140,238	-	-	214	3,739	-	-	11,900	143,977
1959	-	-	11,169	134,023	-	-	464	6,850	-	-	11,633	140,873
1960	-	-	10,032	120,382	-	-	281	4,520	-	-	10,313	124,902
1961	-	-	10,805	129,663	-	-	3,496	48,916	-	-	14,301	178,579
1962	-	-	12,563	150,750	-	-	793	11,660	-	-	13,356	162,410
1963	-	-	14,092	194,915	-	-	2,103	36,577	-	-	16,195	231,492
1964	-	-	17,771	213,255	-	-	5,251	70,769	-	-	23,022	284,024
1965	-	-	16,657	199,887	-	-	23,936	146,123	-	-	40,593	346,010
1966	-	-	24,182	290,160	-	-	49	980	-	-	24,231	291,140
1967	-	-	40,865	180,540	-	-	26	550	-	-	40,891	181,090
1968	-	-	44,634	69,926	113,673	104,504	835	16,702	-	-	159,142	191,132
1969	-	-	69,892	254,430	129,403	137,338	42	980	101	332	199,438	393,080
1970	-	-	-	-	138,567	167,876	28	700	-	-	138,595	168,576
1971	1,324	13,153	151,161	407,303	-	-	5,517	123,180	-	-	158,002	543,636
1972	-	-	-	-	-	-	8,221	191,169	-	-	8,221	191,169
1973	-	-	-	-	3,703	23,590	11,337	267,231	-	-	15,040	299,821
1974	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	12,738	345,546
1975	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	14,880	459,986
1976	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	18,132	549,724
1977	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	21,531	670,922
1978	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	29,946	1,043,623
1979											30,864	1,197,000
1980											35,274	1,513,000
1981					not available						38,580	1,812,000
1982											78,263	2,863,000
1983											38,580	1,932,000

Sources: Statistics Canada Catalogue 26-217 and Canadian Minerals Yearbook of the Canada Department of Energy, Mines and Resources.

tonnes originated in Canada through Ogdensburg. The balance was from France (2,618 tonnes), United Kingdom (1,298 tonnes), Federal Republic of Germany (42 tonnes), Japan (30 tonnes) and Belgium (19 tonnes). Total PCC imports by the United States in 1984 were 9,526 tonnes at an average customs value of $326/tonne.[28]

Prices of various fine pulverized and precipitated calcium carbonate products as quoted in the Chemical Marketing Reporter of October 6, 1986 are:

	Spot and/or List Prices	
Calcium carbonate, pulverized , 325-mesh,		
- bags, bulk, fob works - US$/ton	$ 46.00	-
- slurries, 54% solids, same basis	177.00	-
- slurries, 72% solids, same basis	109.27	
Quicklime, granular, ind., bulk, works - US$/ton	100.93	-
Calcium carbonate, coated, bags, carload, works - US$/lb	0.0830	0.1600
Calcium carbonate, precipitated, bags, carload, truckload - US$/ton	385.00	445.00
Calcium carbonate, precipitated, medium, - bags, carload, works - US$/ton	110.00	150.00
- precipitated, dense, bags, carload, surface treated, works - US$/ton	265.00	-
- ultrafine, US Pharmacopeia, bags, carloads, works - US$/ton	217.00	225.00

28. United States import statistics supplied by Valentin V. Tepordei, Mineral Commodity Specialist, U. S. Bureau of Mines, Telephone (202) 634-1185.

CRUSHED AND BUILDING STONE

In this report, crushed and building stone refers to stone crushed for manufacture of artificial stone, roofing granules, stucco dash, terrazzo chips, rock wool, rubble and riprap, concrete aggregate, asphalt aggregate, road metal and railroad ballast or used as a building stone either in a natural or a finished form. Although poultry grit is considered to be crushed stone in federal government publications, it is included under the pulverized category for this report.

Limestone accounts for some 79% of the quantity of crushed stone produced in Canada, but only 69% of the value. Crushed stone, in turn, accounts for about 92% of total stone tonnage. In both Canada and the United States, limestone comprises about 72% of all stone produced, however, in New Brunswick, it is only 25-35% of total stone. Furthermore, crushed limestone in New Brunswick is only 10-15% of crushed stone. These percentages demonstrate that limestone is made into crushed stone products if it is widely available; however, outside New Brunswick, the lower unit price suggests that many producers price crushed limestone as though it is a secondary product.

Providing the geology and topography allow selective quarrying, lower grade limestone normally is used for what is categorized as crushed stone in this report. For example, Havelock crushes the material that is less than 90% $CaCO_3$ for aggregate.

The output of crushed stone by New Brunswick limestone quarry operators depends on the location of the quarry with respect to urban markets, the existence of major construction projects and alternative markets for the type of rock. Thus, Brookville,

which quarries dolomite near the urban and industrial market of Saint John, markets 60-70% as crushed stone. Most is various types of aggregate. Havelock and Elm Tree, on the other hand, respectively market only 14-18% and 10-12% as various forms of aggregate. Annual production fluctuates much more widely than for other limestone products and generally parallels local business and construction activity. Over the past three decades, total crushed stone output has peaked at 410,267 tonnes in 1956, 703,285 tonnes in 1962, 597,216 tonnes in 1975 and 624,150 tonnes in 1980. These years experienced high levels of business and construction activity. Between 1975 and 1980 production reached a low of 303,910 tonnes and since 1980, it declined to 189,604 tonnes before recovering to 202,304 tonnes in 1985.

Production Statistics

The last year for which Statistics Canada, then the Dominion Bureau of Statistics, published categories of crushed stone by province was 1973. In that year and the previous year, Statistics Canada reported the following (Catalogue 26-217) for New Brunswick.

TABLE XII - NEW BRUNSWICK CRUSHED STONE CATEGORIES IN 1972 AND 1973

	1972			1973		
	Tonnes	Value	$/tonne	Tonnes	Value	$/tonne
Concrete Aggregate	920,527	1,549,178	1.68	263,726	583,976	2.21
Asphalt Aggregate	355,433	558,030	1.57	758,487	1,621,640	2.13
Road Metal	142,899	237,768	1.66	380,642	682,265	1.79
Railroad Ballast	-	-	-	-	-	-
Other	62,984	112,304	1.78	-	-	-
Total Crushed Stone	1,481,843	2,457,280	1.65	1,402,855	2,887,881	2.05

CRUSHED STONE PRODUCTION (SALES) IN NEW BRUNSWICK 1946 - 1983

(STATISTICS CANADA CATALOGUES 26-225 AND PREDECESSOR 26-217)

YEAR	POULTRY GRIT			CRUSHED STONE[2] FOR MANUFACTURE OF ARTIFICIAL STONE, STUCCO DASH, TERRAZZO CHIPS, ROCK WOOL, ROOFING GRANULES, RUBBLE & RIP RAP, CONCRETE AGGREGATE, ASPHALT AGGREGATE, ROAD METAL AND RAILROAD BALLAST			LIMESTONE COMPONENT OF CRUSHED STONE CALCULATED BY SUBTRACTING LIMESTONE FOR CHEMICAL, PULVERIZED & POULTRY USES[3] FROM TOTAL REPORTED LIMESTONE SHIPMENTS			RATIO OF CRUSHED LIMESTONE TO TOTAL CRUSHED STONE	LIMESTONE AND MARBLE PRODUCERS[1]
	Tonnes	$	$/T	Tonnes	$	$/T	Tonnes	$	$/T		
1946	-	-	-	6,604	11,476	1.74	3,251	6,931	2.13	0.49	1-4
1947	-	-	-	109,065	111,244	1.02	5,917	13,044	2.20	0.05	1-4
1948	-	-	-	21,716	44,374	2.04	17,179	37,874	2.20	0.79	1-5
1949	-	-	-	106,691	125,733	1.18	23,755	46,882	1.97	0.22	1-5
1950	-	-	-	2,699,716	3,174,119	1.18	19,809	40,361	2.04	0.01	1-5
1951	-	-	-	703,069	315,484	0.45	36,251	81,866	2.26	0.05	1-6
1952	-	-	-	88,265	108,154	1.22	47,406	89,037	1.88	0.54	1-4,6
1953	-	-	-	837,861	373,861	0.45	60,929	97,221	1.59	0.07	1-4,6
1954	-	-	-	596,058	272,075	0.46	50,470	84,235	1.67	0.08	1-4,6
1955	-	-	-	917,891	918,195	1.00	330,178	395,467	1.20	0.36	1-4,6,7,8
1956	1,361	22,000	16.16	1,882,991	1,713,624	0.91	410,267	430,389	1.05	0.21	1-4,6,7,8
1957	1,521	12,870	8.46	1,112,102	1,197,947	1.08	399,225	560,476	1.40	0.36	1-4,6,7,8
1958	2,265	39,764	17.56	1,839,861	1,468,267	0.80	115,329	149,913	1.30	0.06	1-4,6,7,8
1959	2,849	52,103	18.29	1,847,904	1,300,886	0.70	53,630	27,569	0.51	0.03	1-4,6,8
1960	2,993	52,778	17.63	1,638,764	959,653	0.59	200,538	86,584	0.43	0.12	1-4,6,8,9,10
1961	3,648	54,924	15.06	2,594,807	2,667,091	1.02	224,773	308,746	1.37	0.09	1-4,6,8-11
1962	947	5,274	5.57	2,592,231	2,627,553	1.01	703,285	550,598	0.78	0.27	1-4,6,9,11,12
1963	789	4,740	6.01	3,899,808	3,652,178	0.94	578,916	404,735	0.70	0.15	1-4,6,9,11,13
1964	738	13,024	17.65	2,679,969	2,538,614	0.95	625,680	494,564	0.79	0.23	1-4,9,11,13
1965	715	16,263	22.75	1,815,903	2,331,606	1.28	208,432	353,866	1.70	0.11	1-4,6,9,13
1966	-	-	-	2,897,922	2,010,821	0.69	23,467	39,165	1.66	0.01	1,3,9[5]
1967	3,255	43,306	13.30	2,845,368	2,830,722	1.00	217,125	498,337	2.29	0.08	1,3,9
1968	6,594	65,684	9.96	1,787,917	2,183,397	1.22	306,724	385,808	1.26	0.17	1,3,9
1969	7,480	40,968	5.48	931,248	1,497,677	1.61	111,847	230,535	2.06	0.12	1,3
1970	1,293	9,262	7.16	1,031,884	1,908,826	1.85	102,258	187,855	1.84	0.10	1,3
1971	8,440	65,824	7.80	1,126,343	2,069,933	1.83	227,118	379,238	1.67	0.20	1,3
1972	8,795	58,170	6.61	1,537,572	2,548,428	1.66	216,607	351,378	1.62	0.14	Not Listed
1973	8,925	85,652	9.60	2,301,755	4,514,020	1.96	324,289	784,127	2.42	0.14	1,3
1974	n.a.	n.a.	-	2,660,227	5,881,225	2.21	542,293	1,329,359	2.45	0.20	1,3
1975	n.a.	n.a.	-	2,948,157	6,928,086	2.35	597,216	1,698,390	2.84	0.20	1,3
1976	n.a.	n.a.	-	2,757,507	6,533,385	2.37	451,663	1,328,459	2.94	0.16	1,3
1977[4]	n.a.	n.a.	-	2,875,221	7,849,265	2.73	536,079	2,057,486	3.84	0.19	1,3
1978[4]	n.a.	n.a.	-	2,879,000	7,868,000	2.73	436,000	1,726,000	3.96	0.15	Not Listed
1979	n.a.	n.a.	-	2,864,000	7,662,000	2.68	304,000	1,172,000	3.86	0.11	Not Listed
1980	n.a.	n.a.	-	2,421,000	7,230,000	2.99	624,000	2,508,000	4.02	0.26	1,3
1981	n.a.	n.a.	-	2,070,000	6,415,000	3.10	252,000	1,184,000	4.70	0.12	1,3
1982	n.a.	n.a.	-	1,545,000	5,982,000	3.87	233,000	1,231,000	5.28	0.15	1,3
1983	n.a.	n.a.	-	1,470,000	6,290,000	4.28	190,000	1,165,000	6.13	0.13	1,3

1. Key to limestone producers listed by Statistics Canada
   1. Brookville Manufacturing Co. Ltd.
   2. Elm Tree Limestone Cooperative Ltd. (or successor Elmtree Resources Limited)
   3. Havelock Lime Works
   4. Snowflake Lime Ltd.
   5. Industrial Enterprises Inc. (Randolph at Saint John)
   6. Canada Cement Company Limited
   7. Atlas Construction Co. Limited (Siegas, Madawaska Co.)
   8. York Marble Aggregates Co. Ltd., later York Marble Ltd. (Waterville near Millville, York Co.)
   9. Carleton Lime Co. Ltd., later Moose Mountain Lime Works and Upper Kent Lime Ltd. (Maplehurst area, Carleton Co.)
   10. Atlas Construction Co. Limited (Lancaster)
   11. Lofstrom Construction Co. Ltd. (Saint John)
   12. Atlas Construction Co. Limited (Green Point)
   13. Atlas Construction Co. Limited (Grand Falls)
2. Includes poultry grit after 1973.
3. Poultry use not subtracted after 1974 because detailed usage of limestone not published by Statistics Canada.
4. Values rounded to nearest 1,000 after 1977.
5. After 1965, Statistics Canada no longer lists establishments classified as other industries but which operate limestone primarily for their own supply. Thus, Canada Cement is not listed. Production of crushed stone quarried for use by the lime and cement manufacturers is not included in the crushed limestone statistics throughout the 1946-83 period.

After 1973, the total crushed stone production is listed (Statistics Canada Catalogue 26-225) for the province. Table XIII presents available statistics since 1946 for crushed stone, poultry grit and crushed limestone as well as the producers which reported to Statistics Canada each year. With the exception of poultry grit, higher unit value crushed stone products have been produced in any quantity only during the 1955-1961 period of operation by York Marble Ltd. at Waterville, York County. Table XIV presents a categorization of the higher unit value crushed stone products during this period:

TABLE XIV - CRUSHED STONE PRODUCTS OF HIGHER UNIT VALUE
1955 - 1961 (Statistics Canada Catalogue 26-217)[1]

	Terrazzo Chips			For Artificial Stone			Roofing Granules		
Year	tonnes	$	$/t	tonnes	$	$/t	tonnes	$	$/t
1955	64	1,000	15.53	-	-	-	97	3,250	3.58
1956	-	-	-	-	-	-	1,089	3,900	3.58
1957	218	8,750	27.52	91	2,000	22.05	1,089	3,900	3.58
1958	337	13,478	39.99	-	-	-	1,089	3,900	3.58
1959	618	14,131	22.87	373	7,816	20.95	1,089	3,900	3.58
1960	618	14,131	22.87	373	7,816	20.95	1,089	3,900	3.58
1961	626	14,000	22.36	363	7,800	21.49	-	-	-

Current annual production sales of crushed limestone products is in the following range:

Brookville	140,000 - 150,000	tonnes
Havelock	40,000 - 60,000	tonnes
Elmtree	5,000 - 8,000	tonnes
TOTAL	185,000 - 218,000	tonnes

1. See Table XIII for "Poultry Grit", an additional product of higher unit value.

Products, Specification and Prices

Limestone, dolomite and lime-rich sedimentary rocks are all referred to as limestone by the crushed stone industry. Mineralogical definitions and intermediate varieties are not part of the industry terminology. Instead, the important characteristics and terminology are reflective of market requirements. Specifications are numerous because of the large number and variety of uses. For construction aggregates, the American Society for Testing and Materials (ASTM) provides what is generally regarded as guide or reference specifications. Selected specifications are presented in Table XV. These relate primarily to gradation, but soundness, shape, abrasion resistance, porosity, chemical compatability and content of soft particles are also important.

TABLE XV - DEFINITIONS AND SPECIFICATIONS OF SELECTED CRUSHED STONE CONSTRUCTION USES

Description and specification
COARSE AGGREGATE, LARGE (+1 1/2 inch)
Macadam—nominal gradation from 3 1/2 to 1 in. (90 to 25 mm). ASTM Standard Specification D 693-77 and AASHTO Designations M77-51 and M75-51.
Riprap and jetty stone—heavy irregular rock chunks used for river, harbor, dam, shore, and embankment protection.
Filter stone—crushed stone used as sublayer under graded riprap or jetty stone. Proposed new ASTM Standard.
COARSE AGGREGATE, GRADED
Concrete aggregate (coarse)—nominal gradation from 3 1/2 in. to No. 4 sieve (90 mm to 4.75 mm). ASTM Standard Specification C 33-78.
Bituminous aggregate (coarse)—nominal gradation from 3 1/2 in. to No. 4 sieve (90 mm to 4.75 mm). ASTM Standard Specification D 692-79 and D 448-80.
Bituminous surface treatment aggregate—nominal gradation from 1 1/2 in. maximum. ASTM Standard Specification D 1139-83 and D 448-80.
Railroad ballast—nominal gradation from 1 1/2 in. to 3/4 in. (37.5 to 19 mm). ASTM Standard Specification D 448-80.
FINE AGGREGATE, STONE SAND (-3/8 inch)
Stone sand—concrete—crushed fine aggregate produced from quarried stone, nominal gradation from No. 4 sieve to No. 200 sieve. (4.75 mm to 0.074 mm). ASTM Standard Specification C 33-78.
Stone sand—bituminous mix or seal—crushed fine aggregate produced from quarried stone, nominal gradation from No. 4 sieve to No. 200 sieve. (4.75 mm to 0.074 mm). ASTM Standard Specification C 33-78.
COMBINED, COARSE AND FINE AGGREGATE
Graded roadbase or subbase—nominal gradation from 2 in. (50 mm) to No. 200 sieve (0.074 mm). ASTM Standards Specification C 33-78.
Unpaved road surfacing—nominal gradation from 1 in. (25 mm) to No. 200 sieve (0.074 mm). ASTM Standard Specification C 33-78.

TABLE XVI - CRUSHED LIMESTONE PRODUCTS, USES AND F.O.B. PRICES, 1985-86

	Brookville ($/tonne)		Havelock ($/tonne)	Ontario Milton Quarries[1] ($/tonne)	Usage
	Retail	-3,000 tonnes	+3,000 tonnes			
Quarry Rock					
·quarry run	6.55	5.35	4.70	3.70	-	-bank stabilization, fill, gabions, fireplace and house facing, breakwaters, causeways, etc.
·loader select	8.20	6.90	6.15	-	-	
·rip rap	9.90	8.40	7.30	-	-	
Minus Products					
·6"-0"	7.25	6.25	5.25	-	-	-fill
·1¼"-0"	6.90	5.90	4.90	4.75	5.25	-highway subbase
·¾"-0"	6.90	5.90	4.90	4.80	3.05	-driveway gravel, hard pack road subbase
·¼"-0"	6.90	5.90	4.90	3.70-5.80	-	-recycle for aglime and fertilizer filler, ice control, pipe bedding, driveways
Clear Products					
·3"-1"	-	-	-	4.80	6.00	-mill feed, heavy filter material
·2¼"-¾"	9.75	8.00	6.65	-	-	-mill feed, heavy filter material
·1½"-¾"	9.75	8.00	6.65	-	-	-asphalt roofing, concrete
·1¼"-5/8"	-	-	-	4.80	6.00	-drainage rock
·7/8"-¼" (¾" clear)	9.75	8.00	6.65	-	-	-concrete aggregate
·¾"-¼"	-	-	-	5.00	6.00	-concrete aggregate
·5/8"-¼" (½"clear)	9.50	7.75	6.45	5.50	6.00	-driveways and concrete aggregate, particularly for prestressed
·½"-¼" (3/8" clear)	11.10	9.35	7.90	-	-	-concrete pipe and asphalt roofing
·7/16"-¼"	11.10	9.35	7.90	-	-	-asphalt roofing (pea gravel) and concrete pipe

1. Telephone communication with Bill Griffiths, Manager (416-821-1117)

Although limestone is not specified for any particular use, it meets the specifications for many applications. An example of a use for which it is not desirable is as the aggregate for the "chips" in asphalt chip sealing of highways, particularly routes with high traffic density. The problem is that it is soft enough for the corners and surfaces to become rounded and smooth, thus lessening traction.

Crushed limestone products, uses and prices of producers in the 1985-86 year are presented in Table XVI. Market distribution of the size ranges in greatest demand from Brookville are (Table XVII):

TABLE XVII - MARKET DISTRIBUTION OF BROOKVILLE CRUSHED STONE PRODUCTS

Product	Tonnes	Percentage of Brookville Crushed Stone Production	Main Usage
5/8" x 1/4"	35-45,000	25-30	Driveways and concrete aggregate, particularly prestressed.
7/8" x 5/8" (3/4" clear)	30-35,000	20-25	Concrete aggregate.
3/4" x 0"	18-24,000	12-16	Driveway gravel, hardpack road subbase.
1/2" x 1/4" (3/8" clear)	3-6,000	2-4	Concrete pipe and asphalt roofing aggregate ("granules" or "pea gravel").
Assorted	40-54,000	25-41	Usage as fill, etc., variable from year to year.

Market distribution of crushed limestone products from Havelock and Elmtree is less predictable and, because of their location, the products have a lower unit value. Elmtree's 1985-86 f.o.b. price for their two aggregate sizes (-22 mm + 9.5 mm or -7/8" + 3/8" and -9.5 mm + 3.7 mm or -3/8" + 1/7") was $8.25 per tonne.

LIME

The word "lime" is used generally to refer to forms of burned limestone, that is, quicklime (calcined limestone) and its secondary products, slaked lime and hydrated lime. Quicklime (CaO or CaO.MgO) is formed by the process of calcination, in which limestones are heated to dissociation temperature of the carbonates (as low as 402°C for $MgCO_3$ and 898°C for $CaCO_3$) and held at that temperature for sufficient time to release carbon dioxide. Slaked lime is the product of mixing quicklime and water. Hydrated lime is slaked lime dried and, generally, reground.

Havelock Processing Ltd., a wholly-owned subsidiary of Havelock Lime Works Ltd., was formed in 1970 to produce calcined and hydrated lime. It is the only producer in the Atlantic Provinces and began production to fill the opportunity created after fire destroyed the Saint John calcining plant of Snowflake Lime Limited in late 1968. The 1968 Canadian Minerals Yearbook had reported that "according to railway freight traffic data, over 23,000 tons of lime were off-loaded in the Maritime Provinces during 1968, exclusive of any volume which is moved by truck." The 1971 Yearbook recorded that "Havelock Lime Works Ltd. began production of a high-calcium quicklime early in 1971, utilizing a newly-installed 100 tpd rotary kiln . . ."

The effective capacity of Havelock's rotary kiln was doubled during the 1970's as a result of design modifications and the application of skilled operating practices. Dickenson Mines Ltd. purchased a 60 percent interest in the Havelock Lime group of companies on January 1, 1984 for an assigned value of $6,183,000 of which $2,870,000 was assigned to plant, buildings and equipment; $2,400,000 to mining properties and $893,000 to working capital. The Company had agreed to purchase the remaining 40 percent interest on January 1, 1987 for $3,520,000 plus working capital.[29] In mid-1986,

29. Annual Report 1984, The Dickenson Group of Companies

Dickenson announced plans to install a Fuller annualar shaft kiln with product capacity of 300 tonnes per day. Construction started in October 1986 and the kiln is expected to be in operation by the last quarter of 1987.

Table XVIII depicts the tonnages of lime sold by Havelock in 1984 and 1985.[30]

TABLE XVIII - HAVELOCK SALES OF LIME, 1984-85

	1984 (tons)	1985 (tons)
Quicklime	46,000	45,000
Hydrated lime	27,000	27,000
Total Quicklime Equivalent	67,600	66,600

History

New Brunswick had a long history of lime production prior to the 1968-71 hiatus following the Snowflake fire. Hamilton[31] noted that the "industry grew slowly until 1890, there were about 25 lime-burning units operating in the Saint John area; a thriving lime export trade, with a yearly value of over $100,000, had developed with the United States." However, this export trade did not last after the United States imposed a tariff of 6 cents per hundred weight. Hamilton cites Ells' (1907, p. 117) report on the effect of the tariff: ". . . in 1890 it (shipments to the US) amounted to 284,544 barrels valued at $143,292. Since then the industry has declined, the value for 1897 being only $15,634."

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30. Annual Reports, 1984 and 1985, The Dickenson Group of Companies.

31. Hamilton, J. B., Limestone in New Brunswick, Mineral Resources Report No. 2, Mines Branch, NB Department of Lands and Mines, 1965.

Prior to the establishment of the many kilns in the Saint John area, kilns were operated at numerous localities of limestone occurences throughout the province. These were small (10 square feet x 10 feet high), wood-fired, shaft-type kilns.

Hamilton[32] (1965) presented historical statistics on lime production in New Brunswick from 1886 until 1962. By 1962, production (quick and hydrated) had fallen to 17,061 tons from the recent peak of 32,694 tons in 1950. A sharp decline took place between 1962 and the 1968 fire at Snowflake. In 1965, production was 3,554 tons valued at $101,000. This consisted of 1,915 tons of quicklime valued at $57,000 and 1,639 tons of hydrated lime with a value of $44,000. By 1967 and 1968, the respective total quantities and values were 2,882 tons at $77,245 and 2,607 at $76,006.[33] Table XIX shows the changes in usage of lime sold by New Brunswick and Nova Scotia producers at 10-year intervals between 1935 and 1965. Prior to 1937, New Brunswick and Nova Scotia production are separated in Dominion Bureau of Statistics reports. Table XX compares New Brunswick and Nova Scotia production over the 1923-1936 period. Table XXI lists the operators in the 1925-86 period and Table XXII presents statistics on operations in the 1924-85 period.

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32. ibid, pp. 98-99.

33. Canadian Minerals Yearbooks

TABLE XIX - PRODUCTION OF LIME IN NEW BRUNSWICK AND NOVA SCOTIA SHOWING PURPOSES FOR WHICH USED OR SOLD (X)

(Source: Statistics Canada Catalogue 44-209 and DBS predecessor)

		1935	1945	1955[2]	1965[1,2]
QUICKLIME					
Building Trades -					
Finishing lime	tons	94	-	-	-
	$	1,011	-	-	-
Masons' lime	tons	650	345	1,928	869
	$	6,000	4,219	42,590	30,000
Agriculture	tons	700	-	-	-
	$	4,067	-	-	-
Industrial -					
Iron & Steel plants[(a)]	tons	10,998	2,041	419	68
	$	80,408	24,997	9,256	2,000
Cyanide & flotation mills	tons	-	-	-	-
	$	-	-	-	-
Pulp & paper mills	tons	6,026	13,912	12,776	862
	$	46,355	156,732	267,176	22,000
Sugar refineries	tons	200	180	161	116
	$	1,700	2,201	3,557	3,000
Tanneries	tons	-	4	9	-
	$	-	49	199	-
Other industrial	tons	-	45	-	-
	$	-	4,261	-	-
Other consumers	tons	1,899	1,459	13	-
	$	15,588	22,966	286	-
Total quicklime	tons	20,567	17,986	15,306	1,915
	$	155,129	215,425	323,064	57,000

TABLE XIX (cont'd)

		1935	1945	1955[2]	1965[1,2]
HYDRATED LIME					
Building Trades -					
Finishing lime	tons	40	-	-	-
	$	440	-	-	-
Masons' lime	tons	250	491	1,188	1,221
	$	2,350	6,481	21,025	33,000
Agriculture	tons	650	50	-	72
	$	6,000	660	-	2,000
Industrial -					
Pulp & paper mills	tons	5,600	1,643	1,625	-
	$	40,000	21,688	28,759	-
Sugar refineries	tons	10	40	8	5
	$	90	528	142	-
Fertilizer plants	tons	-	-	-	29
	$	-	-	-	1
Insecticide plants	tons	283	50	-	-
	$	1,840	660	-	-
Water & sewage treatment	tons	-	-	-	212
	$	-	-	-	6,000
Other industrial works	tons	-	150	634	100
	$	-	1,980	11,219	2,000
Other consumers	tons	203	-	100	-
	$	1,624	-	1,770	-
Total hydrated lime	tons	7,036	2,424	3,555	1,639
	$	52,344	31,997	62,915	44,000
GRAND TOTAL	tons	27,603	20,410	18,861	3,554
	$	207,473	247,422	385,979	101,000

(X) Not necessarily consumed in province where produced.

(a) Includes calcined dolomite used as a refractory material.

1 $ values rounded to nearest 1000.

2 No Nova Scotia producer listed or included.

TABLE XX - PRODUCTION OF LIME SOLD OR USED - NEW BRUNSWICK AND NOVA SCOTIA 1923-1936

(Source: Annual Report on the Mineral Production of Canada by Calendar Year, Dominion Bureau of Statistics)

	NEW BRUNSWICK				NOVA SCOTIA			
	Quicklime		Hydrated Lime		Quicklime		Hydrated Lime	
Year	Tons	$	Tons	$	Tons	$	Tons	$
1923	11,534	143,814	-	-	1,518	7,199	-	-
1924	7,287	108,890	-	-	-	-	78	936
1925	7,074	92,216	-	-	2	20	287	3,444
1926	16,704	196,477	-	-	15,633	56,777	251	3,000
1927	12,009	148,321	-	-	30,552	100,134	10	120
1928	11,236	130,484	25	300	35,534	167,386	620	8,490
1929	11,766	135,981	3,752	38,572	41,001	143,787	1,000	10,400
1930	9,947	104,159	2,574	31,145	30,462	106,730	652	6,520
1931	5,161	61,729	6,080	65,325	17,790	73,018	640	6,400
1932	5,547	59,064	6,025	50,120	6,075	30,954	458	4,580
1933	8,059	68,446	8,790	66,340	3,325	24,270	589	5,890
1934	8,949	76,132	6,803	50,277	8,298	63,630	622	4,324
1935	9,569	74,721	6,703	50,054	10,998	80,408	333	2,290
1936	11,004	80,173	6,838	47,843	15,163	113,569	501	5,661

TABLE XXI - OPERATORS IN THE NEW BRUNSWICK AND NOVA SCOTIA LIME INDUSTRY

(Source: Statistics Canada Catalogue 44-209 and predecessors)

Year	Name of Operator	Head Office Address	Plant Location
1925	NB: 1) Peters, C.H. & Sons Ltd.	Ward St. Saint John	Torryburn
	2) Provincial Lime Co. Ltd.	89 Water St. Saint John	Lawlor's Lake
	3) Purdy and Green	323 Main St. Saint John	Saint John[1]
	4) Randolph and Baker, Ltd.	Randolph	Randolph [1,2]
	5) Stetson, Cutler & Co. Ltd.	Campbellton	Indiantown
	NS: 1) Eastern Lime Co. (H.C. Burchell)	Windsor	Windsor[1]
1926	NB: 1,2,3,4,5 and 6) Bathurst Power and Paper Co. Ltd.	Bathurst	Bathurst[1]
	NS: 1) & 2) Dominion Iron & Steel Co., Ltd.	Sydney	Sydney[2]
1927	NB: 1,2,3,5 and 6		
	NS: 1,2		
1928	NB: 1,3,6 and 7) Snowflake Lime Ltd.	3 Pokiok Rd.	Saint John[1,2]
	NS: 1,2		
1929-1932	NB & NS - as 1928		
1933-1935	NB: 3,4,6,7, and 8) Saint John Lime Co.	Brookville	Brookville[1,2]
	NS: as preceding years		
1936	NB: 3,4,6 and 7		
	NS: as preceding years		
1937	NB: 3,4,6 and 7 (#4 ceased to report production after 1937)		
	NS: as 1936		

Year	Name of Operator	Head Office Address	Plant Location
1945	NB: 3,6 and 7 (#8 began reporting production again in 1939 and ceased after 1942)		
	NS: 2 (Eastern Lime inactive after 1943)		
1950	NB: 3,6 and 7 (#7 using only calcium or high calcium limestone from 1946-52)		
	NS: No producers listed after 1948, #2 inactive in 1947 and using Nfld limestone in 1948		
1955	NB: 6 and 7 (1951 was last year of production reported by #3)		
1960	NB: 6 and 7		
1965	NB: 7		
1970	NB: none		
1971-present	9) Havelock Lime Works Ltd.	P.O. Box 59 Havelock, N.B. E0A 1W0	Havelock

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1. Use calcium or high calcium limestone

2. Use dolomite or dolomitic limestone

TABLE XXII: NUMBER OF LIME (QUICK AND HYDRATED) PRODUCING FIRMS, EMPLOYEES, SALARIES AND PRODUCTION - NEW BRUNSWICK AND NOVA SCOTIA

(Sources: Statistics Canada Catalogue 44-209, DBS Annual Reports of the Mineral Production of Canada and Canadian Minerals Yearbook)

Year	Number of Firms	Number of Employees	Salaries and Wages	Fuel Electricity and Process Supplies Used	Capital Employed	PRODUCTION: Tons of Quick and Hydrated Lime, Sold or Used	PRODUCTION: Selling Value at Kiln (Gross)
			$	$			$
1924	6[o]	92[o]	78,327[o]	-	277,147[o]	7,286	108,890
1925	6[o]	67[o]	48,050[o]	-	260,472[o]	7,074	92,216
1926	8[t]	132[t]	97,784[t]	-	292,125[t]	16,703	196,477
1927	7[t]	111[t]	111,709[t]	-	249,865[t]	12,009	148,321
1928	4	67	64,041	-	147,450	11,261	130,784
1929	4	83	73,782	-	166,500	15,518	174,553
1930	4	108[t]	98,639[t]	-	195,331[t]	12,521	135,304
1931	n/a	91[t]	82,948[t]	-	196,524[t]	11,241	127,054
1932	n/a	66[t]	56,527[t]	-	268,091[t]	11,572	109,184
1933	5	84[t]	71,055[t]	-	232,050[t]	16,849	134,786
1934	5	75[t]	63,173[t]	-	205,980[t]	15,752	126,409
1935	5	98[t]	82,575[t]	-	187,381[t]	16,272	124,775
1936	4	121[t]	103,531[t]	-	263,034[t]	17,842	128,016
1937	4	132[t]	128,221[t]	69,030[t]	-	19,899	150,362
1938	3	103[t]	99,090[t]	55,640[t]	235,805[t]	15,247	119,556
1939	4	109[t]	109,925[t]	63,428[t]	195,600[t]	18,675	151,898
1940	4	125[t]	138,955[t]	81,031[t]	209,300[t]	21,236	175,407
1941	4	130[t]	155,376[t]	88,316[t]	203,900[t]	21,752	180,133
1942	4	138[t]	181,751[t]	99,172[t]	204,235[t]	22,427	197,481
1943	3	102[t]	152,150[t]	89,035[t]	202,041[t]	17,382	174,368
1944	3	91[o]	142,793[o]	93,310[o]	n.a.	19,798	227,647
1945	3	n.a.	n.a.	n.a.	n.a.	19,941	241,651
1946	3	"	"	"	"	21,915	286,401
1947	3	"	"	"	"	20,938	295,178
1948	3	70	142,204	74,173	"	22,884	353,621
1949	3	69	144,487	86,274	"	23,082	352,305
1950	3	78	169,678	84,725	"	26,694	387,431
1951	3	70	167,730	94,522	"	20,954	369,681
1952-60	2	---------- data included with BC and NFLD ---------				(See Hamilton, 1965)	
1961	2	----------data included with QUEBEC----------				13,820	308,027
1962	2	"	"	"		17,341	389,876
1963	2	"	"	"		16,919	382,713
1964	2	"	"	"		4,973	126,000
1965	1	"	"	"		3,554	101,000
1966	1	"	"	"		3,734	100,000
1967	1	"	"	"		2,882	77,245
1968		"	"	"		2,607	76,006
1969-70	no production			"			
1971	1	----------data not provided for NB ----------					193,834
1972	1	"	"	"			630,000
1973	1	"	"	"			650,508
1974	1	"	"	"			1,357,036
1975	1	"	"	"			1,302,650
1976	1	"	"	"			1,907,000*
1977	1	"	"	"			2,400,000
1978	1	"	"	"		n.a.	2,331,000
1979	1	"	"	"		n.a.	3,097,000
1980	1	"	"	"		n.a.	3,343,000
1981	1	"	"	"		n.a.	2,935,000
1982	1	"	"	"		n.a.	3,961,000
1983	1	"	"	"		n.a.	4,080,000
1984	1	"	"	"		73,000[x]	5,154,000
1985	1	"	"	"		72,000[x]	5,340,000[p]

t includes data relating to two firms in Nova Scotia
o includes data relating to one firm in Nova Scotia
* rounded to nearest 1,000 after 1975.
x annual reports of the Dickenson Group of Companies

Specifications

According to Boynton[34] (p. 274) a typical range in chemical analysis of commercial high calcium and dolomatic quicklimes in the United States is:

Component	High Calcium Weight % Range	Dolomitic Weight % Range
CaO	93.00 - 98.00	55.00 - 57.50
MgO	0.30 - 2.50	37.00 - 41.00
SiO_2	0.20 - 2.00	0.10 - 1.75
Fe_2O_3	0.10 - 0.40	0.05 - 0.04
Al_2O_3	0.10 - 0.60	0.05 - 0.05
CO_2	0.40 - 2.00	0.40 - 2.00
SO_3	0.01 - 0.10	0.01 - 0.10
P	trace - 0.05	trace - 0.05

Havelock's specification sheet for their typical ground quicklime used in pulpmill causticizing systems gives the following data:

Chemical analysis:	CaO	94.0%
	MgO	1.0%
	Fe_2O_3	0.3%
	Al_2O_3	0.5%
	SiO_2	2.0%
Available Lime:	Minimum 88% (represents total free or active CaO content in a quicklime or hydrate and provides a means of evaluating the effective lime concentration)	
Reactivity:	Temperature rise of 40°C in less than 3 minutes.	
Bulk Density:	57.8 lb/cu.ft.	

34. Boynton, R. S., Chemistry and Technology of Lime and Limestone, 2nd Edition, John Wiley & Sons, Inc., 1980, 578 pp.

Particle size analysis:

	Retained
½ "	0%
¼ "	3.5%
6 mesh	25.5%
12 mesh	26.6%
50 mesh	29.0%
100 mesh	4.9%
Pan	10.5%

Table XXIII compares properties of high calcium quicklime of various producers in eastern Canada and northeastern United States. The Havelock product is similar to the others, but may have a lower available lime.

Hydrated lime specifications were not obtained from Havelock, however, since the typical Havelock quicklime analysis is similar to that of Jolichaux, it is reasonable to assume that the Havelock hydrated lime is also similar to the following Jolichaux specifications:

Chemical Composition (%):

CaO	73.7
MgO	0.7
SiO_2	1.5
Fe_2O_3	0.2
Al_2O_3	0.2
S	0.08
L.O.I.	23.6

Available Lime as %

Calcium Hydroxide $Ca(OH)_2$	91.0
Neutralizing Value ($CaCO_3$=100)	132
Calcium Carbonate (% $CaCO_3$)	2.2

Screen Analysis (% passing):

Mesh (Tyler)	ISO Sieve	
48	0.300 mm	96
100	0.150 mm	92
200	0.075 mm	86
325	0.045 mm	80

TABLE XXIII: TYPICAL SPECIFICATIONS OF SOME HIGH CALCIUM QUICKLIMES OF VARIOUS PRODUCERS

		Pfizer[1] Adams, Mass.	Jolichaux Joliet, PQ	Domtar[1,2] Beachville, Ont.		Havelock[1] Havelock, NB
Product Characterization		Granular	Pulverized-6 mesh	1/4"	1/4x3/4"	"ground"
Chemical Composition (%):	CaO	94.0	94.5	95.5	95.3	94.0
	MgO	0.7	0.8	1.0	1.0	1.0
	SiO_2	1.8	2.5	0.75	0.75	2.0 -3.8
	Al_2O_3	0.4 -3.0	0.5 -4.2	0.15	0.10	0.5
	Fe_2O_3	0.1	0.3	0.15	0.10	0.3
	S	N/A	0.1	0.03	0.03	N/A
	L.O.I.	0.3	1.2	2.5	2.7	N/A
Available Lime (%)		93	90	92	93	88 (minimum)
Water Reactivity - ^oC rise in 30 sec.		24^o	22^o	20^o	25^o	to 40^o in
(slaking rate) - ^oC rise in 3 min.		N/A	50^o	N/A	N/A	less than 3 min.
		N/A	55^oC(6)	38^o(5)	41^o(5)	N/A
Bulk Density (lb./cu.ft.)		68.72	65	N/A	55	57.8
Sieve Opening (% passing)						
19	mm	---	---	---	95	-----
12.5	mm	---	---	---	45	100
6.3	mm	---	---	---	5	96.5
4.75	mm	---	100	100	---	-----
3.35	mm	---	98	---	---	71
2.36	mm	---	95	65	---	-----
2.00	mm	100	---	---	---	-----
1.68	mm	---	---	---	---	44.4
1.40	mm	---	85	---	---	-----
1.18	mm	---	---	44	---	-----
0.60	mm	---	70	35	---	-----
0.30	mm	---	---	25	---	15.4
0.15	mm	2	---	15	---	10.5

1 From product specification sheets provided by companies. Different specifications may appy to certain other lime products of the companies.

2 Purchased by Beachvilime Ltd. in 1985.

Prices

Havelock lime did not provide official list prices for quicklime or hydrated lime, however, the 1985 f.o.b. prices averaged in the $74-82 per ton range. The lower end of this range was derived by dividing Statistics Canada's preliminary value of lime production reported for 1985 by the quantity of lime sold by Havelock during 1985 (Dickenson Mines Limited annual report for year ended December 31, 1985). The upper end of the range is based on verbal advice of company officials about their list or "official price" for hydrated lime. The quicklime price is apparently about 40-60 cents per ton less than the price of hydrated lime. Both prices refer to bulk shipments, generally of 25 tons or more. Neither quick or hydrated lime is bagged.

Prices of various products, f.o.b. several eastern North American plants are presented in Table XXIV:

TABLE XXIV: LIME PRICES FROM PRICE LISTS OF VARIOUS PRODUCERS, 1985-6
(Canadian dollars per short ton, f.o.b. plant)

Trade Name or Size Range	Lee Lime Corporation Lee, Mass.		Beachvilime Limited, Ingersol, Ont.		Jolichaux/Domlim Joliette or St. Adolphe de Dudswell, Quebec		Pfizer, Adams, Mass.		
	Bag	Bulk	Bag	Bulk	Bag	Bulk	Bag	Semi-Bulk	Bulk
Run of kiln						63.25			
Screened						63.25			
Fines				58.50-59.00		63.25			
"Crushed - 3/16"			106.20		104.38				
Screened - 3/4" x 3/16"					104.38				
"Pulverized" - 8 mesh					104.38				
t 3/4 Lump				62.00-63.00					
1/4 x 3/4 Lump				58.50-59.50					
"Minute Man Plastic Lime"	135.40	121.50							
"Kwik-Lee Pulverized Quicklime"	185.40								
"High Calcium Chemical"							138.90	129.17	97.92
"Granular Industrial"								135.40	
"Tobey Agra Hydrate"	124.30								
Agricultural Spray Hydrated Lime	136.80				97.28				
Hydrated Lime			95.05	68.00	97.28	66.47			

List prices of bagged quicklime at two Quebec and Ontario plants are $40-48 per ton high than bulk quicklime (Jolichaux and BeachviLime, 1984-5, f.o.b. plant). Bags are 25 kg or 50 lbs. and usually 3 ply Kraft paper. Hydrated lime in bags of a similar size and material is usually priced $6-10 per ton less than bagged quicklime. Boynton (ref. #34, 1980, p. 378) noted that bagging added about $11 (US) per ton to costs and/or prices. If this is adjusted for subsequent inflation and for the differential in the value of the Canadian and United States dollars, the bagging cost in Canada today would be in the $16-20 per ton range. Thus, there would appear to be a greater profit margin on bagged lime than bulk lime.

In 1985, approximately 30 tons of lime was exported to Greenland from New Brunswick and 11,682 tons to the New England states. Value declared to customs according to unpublished tabulations maintained by the New Brunswick Statistics Agency was $81.44 and $77.38 per ton, respectively.

The Chemical Marketing Reporter of October 6, 1986 lists the following price ranges for lime products:

	Spot and/or List Prices
Lime, chemical, pebble (quicklime), bulk, 50,000 lbs., works, f.o.b. plants, US$/ton	39.00 - 45.00
Lime, chemical, hydrated, bulk, same basis	46.00 - 50.00
Lime, chemical, hydrated, bags, same basis	54.00 - 57.00
Lime, National Formulary, purified, 100 lb. drums	US $0.69/lb.

The Chemical Marketing Reporter prices probably reflect the effects of competition much more than the list prices of any one producer, particularly any one producer in the New England States or Atlantic Provinces. The smaller differential between bulk and bagged prices in the United States is assumed to reflect economics of scale achieved in a larger marketplace

If one divides the value by the quantity of lime (quick and hydrated) exported from New Brunswick to the New England States according to unpublished tabulations maintained by the New Brunswick Statistics Agency, the result is probably a fair respresentation of the New Brunswick lime price history. This history since 1974 is depicted in Table XXV.

TABLE XXV: LIME EXPORTS FROM NEW BRUNSWICK, 1974 - 1985
(QUICK AND HYDRATED)

(Source: NB Statistics Agency, unpublished tabulations by Statistics Canada)

	USA			French West		
	New England	Other	Greenland	Indies	Total	$/ton
1974-tons	18,823	150	-	-	18,973	22.71
-C$	429,111	1,725	-	-	430,836	
1975-tons	13,911	312	-	-	14,223	25.10
-C$	348,967	8,019	-	-	356,986	
1976-tons	15,419	-	-	-	15,419	36.72
-C$	566,218	-	-	-	566,218	
1977-tons	23,289	66	-	26	23,381	35.26
-C$	831,411	1,971	-	991	824,373	
1978-tons	13,622	35	-	-	13,657	37.27
-C$	507,733	1,225	-	-	508,958	
1979-tons	22,824	135	-	-	22,959	39.75
-C$	906,942	5,580	-	-	912,522	
1980-tons	17,495	25	30	-	17,550	47.64
-C$	833,621	1,051	1,496	-	836,168	
1981-tons	12,332	55	-	-	12,387	55.11
-C$	679,441	3,171	-	-	682,612	
1982-tons	10,124	-	-	-	10,124	57.78
-C$	585,008	-	-	-	585,008	
1983-tons	12,727	67	26	-	12,820	68.10
-C$	866,610	5,533	871	-	873,014	
1984-tons	9,567	-	-	-	9,567	70.95
-C$	678,797	-	-	-	678,797	
1985-tons	11,682	-	30	-	11,712	77.39
-C$	903,935	-	2,469	-	906,404	

Transportation and Handling

Table XXVI illustrates how transportation cost influences the competitive position of Havelock in supplying the Maine markets for quicklime. Truck shipments would be a minimum of 25 tonnes, generally in pneumatically self-unloading vehicles. Rail shipments would be in covered hopper cars of 140,000 pounds minimum weight.

TABLE XXVI: TRANSPORTATION COST FROM COMPETING LIME PRODUCTION AREAS TO SELECTED MARKET AREAS

(Source: Atlantic Provinces Transportation Commission)

	Old Town-Great Works, ME		Millenocket, ME	Rumford, ME	
Lime Producing Area	Truck (¢/2,000 lb)	Rail (¢/2,000 lb)	Truck (¢/2,000 lb)	Rail (¢/2,000 lb)	Truck (¢/2,000 lb)
Joliette, PQ	-	4,741[2]	3,361[3] (540-600 km)	5,034[4]	-
Sherbrooke, PQ	-	-	2,731[3] (440 km)	-	-
Havelock, NB	2,620[1] (434 km)	-	2,540 (407 km)		4,160[1] (596 km)

Lime is shipped by truck or in 20 foot rail containers from Havelock to Long Harbour and St. John's, Newfoundland. Very little quicklime of other producers is competitive in Newfoundland, however, the bagged hydrated lime sold in Newfoundland is sourced in Quebec because Havelock does not produce a bagged product. The quick and hydrated lime bulk trucking tariff of A&M Transport Ltd. in 1984-5 to St. John's was $113.33 per ton, before the 10% reduction under the Atlantic Region Special Selective Assistance Regulations and applicable only on goods grown, mined, harvested or subjected to a manufacturing process in the Atlantic Region. The comparable 1985-6 rate was $119.67 per ton. The tariff for 20 foot rail container shipment from Havelock to Long Harbour, Newfoundland for 1985-6 was 363¢/100 lb. (or $72.60/ton) before the 10% reduction.

For trucking and rail tariffs of lime and other limestone products to various destinations or for various distances, the reader is referred to Appendix V.

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1 Effective October 1, 1985, A&M Transport Ltd. tariff "H" for Havelock Processing Ltd.

2 Effective August 24, 1985 including 22% currency exchange surcharge for payment in Canadian funds.

3 Estimated or potential rate, 1984.

4 Estimated 1985 rate based on published rate for 1984.

Certain customers with modest to intermediate lime requirements have the capability of handling intermediate bulk containers. These units can result in handling and packaging cost savings relative to bags. Most intermediate bulk containers consist of a reusable woven fibre case with draw strings at the top and bottom, a plate across the bottom opening and straps at the top for lifting. Disposable polyethelene liners are inserted before filling the container. Various sizes are available, but 1,200 litres (104 cm x 104 cm x 112 cm high) and 1,700 litres (104 cm x 104 cm x 158 cm) are common capacities. Havelock has at least one unit of the latter size. Steetly Industries Ltd. of Hamilton, Ontario ships dolomitic lime in such containers with up to 6,000 kilogram capacity. These are returnable for 6 or more refills and reportedly result in a 20-25 % saving for the user relative to 50 pound bags.[36]

Canadian suppliers of custom made unit packs or intermediate bulk containers are:

Twin Pack, Brantford, Ontario
Bonner Packaging, Burlington, Ontario
Bag Corporation, Winnipeg, Manitoba

Lime is shipped by barge in Europe and the United States, paricularly along the Mississippi River system in 2-3,000 ton shipments. In the United Kingdom, Steetly Industries ships quicklime by barge from Newcastle to Luelo, Sweden. Limitations on barge shipment and volume are weather and limited size of storage facilities. For instance, the largest storage capacity for quicklime in the United States is 5,000 tons at the New Baunfelds plant of US Gypsum in Texas. Storage is always in concrete or steel silos and concern about moisture implications probably has limited the capacity of storage facilities.

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36 Brian Galt, Steetly Industries Ltd., Hamilton, Ontario, 416-527-3671, personal communication.

MARKETS

(see Appendix VI for additional data on
relevant Eastern United States Market Areas)

TABLE XXVII

PRINCIPAL SPECIFIC QUICKLIME MARKETS WHICH ARE SERVED OR POSSIBLY COULD BE SERVED FROM NEW BRUNSWICK

	USER, PLANT LOCATION AND CONTACT	ANNUAL CONSUMPTION (tonnes/year)	CONSUMPTION DECREASING OR INCREASING	SUPPLIER(S)	SPECIFICATIONS	OTHER
1.	Irving Pulp & Paper Ltd. P. O. Box 3007, Stn B Saint John, N.B. E2M 3H1 Dave Collins, Manager Purchasing & Stores (506) 635-6666	3-4,000	Static	Havelock and Jolichaux, P.Q.	- 3/4" and ideally 90% availability	- Material purchased from Jolichaux to maintain competitive pricing by Havelock. Delivered from Quebec by rail. - Of the Rothesay, Lake Utopia and Reversing Falls mills, only the latter uses lime.
2.	Fraser Inc. 27 Rice Street Madawaska County, N.B. E3V 1S9 Roger Michaud Purchasing Manager Edmundston & Atholville Plants (506) 735-5551	9-12,000*	Static	Havelock	- Grit must be less than 3/8" - 86% to 90% solids	- Use equal amounts at Edmundston and Atholville mills in settling sand lagoons.
3.	George Pacific Corporation Woodland, Maine Scott Austin or John Nixon, Purchasing (207) 427-3311	5,500	Expected to decrease by 100 t over next four years	Havelock (most) and Jolichaux (Domlim)	- Standard pebble quicklime	- Normally would purchase most of requirement from Havelock because most economical, however in 1985 Havelock was unable to supply so purchase about half from Quebec.
4.	Consolidated Bathurst, Inc. New Richmond, P.Q. Len Gallon (418) 392-4474	15-1,800	Static	Havelock	- Size 3/16" - 3/4"	In addition, consume about 4 tonnes of crushed quicklime in 80# bags.
5.	Great Northern Paper Co. Millinocket, Maine Mr. Vaznus, Purchasing Agent (207) 723-5131	6,800	Static	Havelock and	- Very fine grained and will tolerate no grit.	For several years dropped Havelock as supplier because of grit.

	USER, PLANT LOCATION AND CONTACT	ANNUAL CONSUMPTION (tonnes/year)	CONSUMPTION DECREASING OR INCREASING	SUPPLIER(S)	SPECIFICATIONS	OTHER
6.	Lincoln Pulp & Paper Co. Inc. Lincoln, Maine Ed Pelkey	4,000	Static	Domlim and Havelock	- Standard pebble quicklime and prefer lime availability in the high 80's.	Consume 75 lbs of lime per ton of pulp
7.	James River Corporation Old Town, Maine Ms. "Jo" Davis (207) 827-7711	8-9,000	Static	Not Available	- Standard pebble quicklime	
8.	S. D. Warren Co., a Division of Scott Paper Co. Westbrook, Maine Cathy Knox, Purchasing (207) 856-6911	1,800	Static	Not Available	- Standard pebble quicklime as for other S. D. Warren mill.	
9.	Boise Cascade Corp. Rumford, Maine Beverly in Purchasing Department	3,600	Static	Domlim and Pfeizer	- Standard pebble quicklime	Quicklime purchased as back-up and "make up" for company's own lime kiln.
10.	S. D. Warren Co., a Division of Scott Paper Co. Skowhegan, Maine Dick Bartlett (207) 453-9301	6,800	Static	Pfeizer and Domlim	- Standard pebble quicklime like CaO+90% and insolubles less than 1.5%	Consumption down from about 9,000 tonnes/yr a number of years ago, but further reductions not expected. Used to purchase from Havelock, but did not have capacity to supply whenever required so dropped them as a supplier. Would likely resume purchases from Havelock, if it were to expand.
11.	Scott Maritimes Ltd. New Glasgow, N.S. "Jim" Horton (902) 752-8461	0-2,700	Static	Havelock	- Standard pebble lime.	Purchase lime only when kiln at mill is shut down for repair or maintenance. Use local limestone for kiln from quarry owned by
12.	Heath Steele Mines Ltd. Box 400, Newcastle, N.B. E1V 3M5 John Martin, BM&S (506) 546-6671	4,000	Static	Havelock	- Standard ground lime	Consumption could increase if mining is resumed in late 1980's or early 1990's (see Table XXVII).

	USER, PLANT LOCATION AND CONTACT	ANNUAL CONSUMPTION (tonnes/year)	CONSUMPTION DECREASING OR INCREASING	SUPPLIER(S)	SPECIFICATIONS	OTHER
13.	Brunswick Mining and Smelting Corporation Limited P. O. Box 3000 Bathurst, N. B. E2A 3Z8 John Martin (506) 546-6671	9,600	Static	Havelock	- Standard ground lime	Beginning in 1986-87 and replaces part of hydrated lime consumption (see Table XXVII).
	TOTAL	63-71,600				
14.	Miscellaneous - St. Anne-Nackawic (420 tpy); Miramichi Pulp & Paper (125 tpy)					

*estimated on basis of old documentation as purchasing agent would not divulge consumption.

TABLE XXVIII

SPECIFIC DEVELOPING OR PROSPECTIVE MARKETS IN THE ATLANTIC REGION FOR QUICK AND HYDRATED LIME

	Market	Quicklime	Hydrated Lime	Year Consumption Expected to Commence	Comments
A.	DEVELOPING MARKETS				
	Hope Brook Gold Inc. Cinq Cerf Bay Newfoundland (South Coast) (Ref. Godfrey McDonald, 416-361-0794)	6,300	±750 --	August 1987 and ending January 1989 4th quarter of 1988	Heap leaching gold from 762,000 tonnes of ore for 17 months then mining by underground at 3,000 tpd. Underground ore contains chalcopyrite and pH must be kept in 11-11.5 range to avoid dissolution of copper at the same time as gold.
	Gordex Minerals Ltd. Saint John, N. B. (Ref. Hal. Pawson, 633-2088)		200-250	1986	Heap leaching gold from 150,000 tons of ore/year.
	Brunswick Mining and Smelting Corporation Ltd., Bathurst, N. B. (Ref. Jim Schnarr, 546-6671)	9,600	6,500	1987 (late 1986)	Slaker being installed to make hydrated lime for mill pH control and treating #12 mine acid water drainage. Final tailings pond effluent and #6 mine drainage will continue to be treated with hydrated lime from Havelock (also recorded on TABLE XXVII).
B.	PROSPECTIVE MARKETS				
	Northumberland Mines Ltd. Bathurst area, N.B. and/or Guysborough Co., N.S.		100-500	Unknown	Gold properties in exploration and feasibility stages.
	±2 other gold mines in N.B., N.S., Nfld. or Maine.		±500	±1990	
	Susco Inc. Sydney, N.S.	±25,000		+1990	Unless modernization plans are abandoned, the electric furnace will require a switch from dolomite and limestone to quicklime. It has not been decided whether quicklime would be manufactured by Sysco. In 1973 a 300 tpd Calcimatic kiln was purchased in anticipation of a modernization. It has never been used.
	Heath Steele Mines Ltd.	±6,000	3,000	+1990	Providing milling is resumed, either as a result of real metal price increases or delineation of sufficient ore of higher grade than previously mined.

TABLE XXIX

Specific Bulk Hydrated Lime Markets

	Hydrated Lime Buyer	Principal Supplier(s)	Minimum Annual Purchased (tonnes)	Cumulative Market (tonnes)
1.	Gaspé Copper Mine Murdochville, PQ	Havelock	2,000 6,300[1]	2,000 8,300
2.	ERCO Industries Ltd. Long Harbour, NF	Havelock	4,750[2]	13,050
3.	Fredericton, NB	Havelock	160	13,210
4.	Heath Steele Mines Ltd. Newcastle, N. B.	Havelock	2,600[3]	15,810
5.	Brunswick Mining and Smelting Corp. Ltd.	Havelock	6,500[3]	22,310

[1]6,300 - 8,000 tonnes/year for pH control in mill when operating at normal rate plus 2,000 - 2,500 tonnes/year for treatment of tailings and run-off, whether operating or not.

[2]Terra Transport - 20 foot rail containers, minimum weight 45,000 lbs.

[3]After 1986.

TABLE XXX

Specific Bagged Hydrated Lime Markets

	Hydrated Lime Buyer	Principal Supplier(s)	Annual Purchase (tonnes)	Cumulative Market (tonnes)
1.	Consolidated Bathurst Inc. New Richmond, PQ	n/a	2	2
2.	Summerside, PEI	Domtar	5	7
3.	Sydney, NS	n/a	50	57
4.	St. John's, NF	n/a	61	118
5.	Grand Falls, NF	Domlim	27	145
6.	Dartmouth, NS	Domtar	180	325
7.	Nova Scotia (general-ref. Howard Industries Ltd.)	Domlim & Jolichaux	600 (est.)	925
8.	La Compagnie Gaspesie Ltée Chandler, PQ	Dearborn Chemicals	30	955
9.	International Minerals & Chemical Corp., Orrington, ME	n/a	2	957
10.	Bangor, ME	n/a	55	1,012
11.	Bath, ME	n/a	36	1,048
12.	Hamblet & Hayes Co. Polar Chemicals Div. Lewiston, ME	Domlim & others	200	1,248
13.	New England Chemical Co., Westbrook & Houlton, ME	Domlim & others	600	1,848
14.	W. H. Shurtliff Co. Brewer & Portland, ME	n/a	100	1,948
15.	Bermuda	n/a	350	2,298
16.	Gordex Minerals Ltd. Saint John, N.B.	Havelock	200-250	2,498
17.	Mount Pleasant Tungsten Mines, Charlotte Co., NB	Jolichaux	40-50	2,538
18.	Bathurst, N.B. 1985-560 bags @ $10.90/50 lb.bag	W.J. Kent (Allied and Gulfstream Products)	11-13	2,549
19.	Woodstock, NB	n/a	0.25	2,549

CEMENT

Cement is a manufactured product of which limestone is the most significant ingredient. Thus, this report does not include cement per se, except for the discussion in the "overview" section and the statistics on annual consumption of limestone for cement manufacture.

4. CONCLUSIONS AND RECOMMENDATIONS

1. New Brunswick limestone producers have costs and prices generally in line or slightly higher than other Eastern North American producers. This will also apply to lime, when the new kiln is installed at Havelock.

2. The industry considers underutilized capacity to be one of the major problems. Crushing and milling capacity, excluding for manufacture of cement, is over 1,500,000 and 550,000 tonnes per annum, respectively. This compares with annual respective needs for crushing and milling capacity of approximately 575,000 tonnes and 190,000 tonnes. Obviously, if more markets were available, utilization of facilities would improve and unit cost of production could be lowered.

3. Suggestions from industry representatives include:

   - simplify agricultural limestone subsidy

   - modify agricultural limestone subsidy so as not to discourage development of limestone deposits in areas of greatest agricultural usage

   - government should promote more custom agricultural limestone spreading to increase market

   - stop brokers from buying agricultural lime at subsidized price, then shipping material to Maine for a profit which includes the subsidy

   - increase public, industry and municipal awareness of limestone and lime usefulness and applications of benefit to them

4. Of the many alternative existing and emerging uses which were reviewed for lime and limestone, only those are discussed in this report which have potential to be important markets or result in reasonably significant market growth of consequence to New Brunswick producers. These markets, in order of decreasing prospective significance for existing producers, are:

   - as a filler in paper replacing clay, particularly in Maine, where, with market development initiative, the potential exceeds 100,000 tonnes per annum for precipitated calcium carbonate (PCC) plus a similar amount of ground calcium carbonate (GCC)

   - for pollution control by acting as a captor for sulphur at electricity generating plants burning coal or oil with a high sulphur content, with particular potential at the Coleson Cove plant and prospective plant for burning coal and oil shale should results of trial operations at Dalhousie and Chatham be technically and economically encouraging (combined market could approach 750,000 tonnes per annum, but is unlikely to develop before early 1990's)

   - for pH control at gold mining operations to avoid cyanide gas being emitted (Hope Brook gold mine in Newfoundland and Gordex gold mine at Saint John are expected to be the first of several which cumulatively could require about 10,000 tonnes of hydrated lime by the early to mid-1990's)

   - for manufacture of MgO from dolomite as a step in the production of magnesium metal and other magnesium-based products (if Norsk Hydro choses to use New Brunswick dolomite for a Quebec plant instead of another source, up to 750,000 tonnes per year could be quarried and processed to MgO at Lorneville, with little or no impact on existing producers)

5. Total limestone production currently appears to be at a cyclical low. If the above markets emerge they would bring the production back above the long term trend line which displays an annual growth increment of 11,946 tonnes, or slightly under 2 percent at the current annual rate of production.

6. Encouragement for the paper industry to switch from clay to calcium carbonate filler should be of importance as a component of the forest resource management plan of the region. There is a developing shortage of wood fibre because reforestation did not begin early enough to supply long term mill requirements. Since calcium carbonate filler can make up as much as 18 to 20 percent of paper compared with only 10 to 15 percent filler when clay is used, the impact of the potential fibre saving should be considered. Companies should also be encouraged to incorporate calcium carbonate filler because it is a less costly paper ingredient than wood fibre.

7. Governments should consider the following measures to encourage growth of the limestone industry for regional benefit:

   a) contribute toward the cost of testing to determine whether acceptable quality PCC can be produced from NB limestones and quicklime;

   b) investigate known limestone occurrences to determine whether any are white enough for production of acceptable GCC;

   c) provide some form of incentive for custom aglime spreaders to become established and continue to provide the service in regions of farming activity, particularly those areas where the low to moderate intensity of farming activity has not resulted in custom spreading;

d) review the agricultural limestone assistance policy in consideration of what effect the declining real or constant dollar value of the assistance has had on usage decisions, and also in consideration of the level and form of assistance elsewhere;

e) contribute to the cost for trial purchases of lime and limestone products by prospective users which would be willing to test new applications, providing continuation of the usage would result in meeting environmental or productivity objectives of benefit to the region.

8. The value to New Brunswick of the production of limestone useful for a variety of applications is much more in the environmental quality, industrial diversification and agricultural productivity that is facilitated by this versatile material, than in the jobs that are created by the mining and direct processing of limestone. Present government policy and programs should emphasize enhancement of the markets that exist or could reasonably be developed so as to create the demand that will lead to greater competition and the lowest cost for consumers.

The agricultural limestone asistance program, in operation for more than six decades, is a clear demonstration of how demand for limestone can be influenced. Without this program the existing limestone producers almost certainly would not have had the production base to remain in business and diversify output.